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US Army Research Laboratory

Informing the Long-Term Learner Model: Motivating the Adult Learner (Phase 1)

by Lauren Reinerman-Jones, Elizabeth Lameier, Elizabeth Biddle, and Michael W Boyce

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14. ABSTRACT
The United States (US) Army has valued training across a wide range of performance areas and has used a variety of platforms to instantiate the training seen as the best fit for the knowledge, skills, and abilities required for mission success. As the United States is coming out of wartime, an opportunity is available to consider the effectiveness and cost of training programs and platforms. The Army is developing a framework for providing personalized, on-demand, computer-based instruction under the Generalized Intelligent Framework for Tutoring (GIFT) program. Of particular interest for this effort is understanding the intersection of personality factors, motivation, and reinforcers that are relevant to informing the Long-Term Learner Model. The approach proposed is to use existing data as a starting point for identifying important correlates of the aforementioned concepts and evaluating their application within a learning/training environment. The goal is to develop a motivator capability that can be incorporated into GIFT. Phase 1 focused on the initial development of a Motivator Assessment Tool (MAT) and integration of the MAT in GIFT for purposes of validation. The focus for Phases 2 and 3 will be to refine the MAT based upon validation experiments and implement that version as an adapting strategy in GIFT for learning in a determined task. The expectation is that targeted motivator adaption strategy will increase the rate and retention of learning.

15. SUBJECT TERMS
adaptive tutoring, individualizing motivators, Motivator Assessment Tool, motivation, learning rate and retention

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1. Introduction

The United States (US) Army has valued training across a wide range of performance areas and has utilized a variety of platforms to instantiate the training seen as best fit for the knowledge, skills, and abilities required for mission success. As the United States is coming out of wartime, an opportunity is available to consider the effectiveness and cost of training programs and platforms. In particular, military training has primarily focused on the principles of instructional systems design (ISD) as a means to meet the need of rapid training for force-protection capability. Instructional designers (IDs) identify learning objectives based on needs, which are specific to a task or mission and then develop experiences that consist of interventions to meet those learning objectives. To be clear, due to the wartime needs, training has been the emphasis rather than learning. Training is giving information to a trainee. That trainee is not always a learner. The learner has to be motivated to process and internalize the information for actionable use. That process is learning.

The present effort utilizes learning sciences, which includes principles of both training and learning. The specific objective for this effort addresses motivation as an individual difference that can be adapted in training to enhance learning rate and retention.

1.1 Identifying the Highest Impact Gap

The US Army Research Laboratory (ARL) is continuing to develop a framework for providing personalized, on-demand, computer-based instruction using the Generalized Intelligent Framework for Tutoring (GIFT; Sottilare et al. 2012; Sottilare 2016; Sottilare et al. 2017). A variety of gaps exist pertaining to individual differences and learning that might inform intelligent tutoring systems (ITSs) for use in GIFT (Sottilare et al. 2012; Goodwin et al. 2015). Increasing the level of relevance and value of this project for GIFT was a top priority. ARL, the Institute for Simulation and Training (IST) at the University of Central Florida (UCF), and The Boeing Company reviewed a list of 26 research questions, provided by IST, to identify a topic most relevant to the needs of GIFT. The collaborative meeting among all parties narrowed the questions down to the top 3. The questions were refined after the discussion and the final question addressed by this effort is: how do individual differences in motivation affect the learning rate and retention of a given learning task?

That question pertains to training that increases time to mastery of knowledge and skills, and retention in a learner. Motivation is an individual learning difference

encouraged through personalization of learning with reinforcers (Graesser et al. 2016). An ITS can provide adaptations at an individualized level to support the learner's motivation tendencies, thus deemed an area ripe for extending into GIFT. The present research meets areas of need, identified for ARL by Goodwin et al. (2015), by providing more sufficient adaptation for understanding the individual learner's motivational traits and personalizing instruction accordingly. Therefore, addressing motivation in an adult learner fills a need for ITSs, which is to have the ability to connect adaptive training, education, and the Long-Term Learner Model (LTLM; Goodwin et al. 2015), accomplished by developing models that allow highly tailored training for increased learner readiness.

1.2 Enhanced GIFT via Phases

An enhanced GIFT capability is being achieved through three 1-year-long phases. Phase 1 focused on the classification of learning motivation and the evaluation of the resulting process. Phase 2 involves the administration of a verification experiment. Phase 3 entails a validation experiment. The goal for this report is to demonstrate the process executed and products delivered in Phase 1.

2. Phase 1 Execution

Phase 1 involved the development of the Motivator Assessment Tool (MAT) to enhance GIFT by providing a means to tailor motivational strategies. The MAT assesses motivation traits of the learner and environmental factors influential to motivation. Those variables are associated with types of motivational reinforcers, henceforth called motivators. The result from a learner taking the MAT is motivators that work best for the life of the learner, and thus, those individualized motivators can be implemented in training to adapt the learning experience. First, MAT development is essential because few currently established adult motivation assessments exist. Most of the published motivation assessments are aimed at school-age populations (e.g., Harter 1981; Vallerand et al. 1992; Midgley et al. 2000), rather than adult populations (Amabile et al. 1994). Second, the MAT strives to compile a comprehensive picture of a person's motivation. Many of the established assessments only look at one variable. Very few look at multiple variables and none of the assessments reviewed are as comprehensive as the MAT.

To create such an assessment, the first task was to conduct an extensive literature review regarding motivation, individual differences, physiological data, and learning rate and retention. This task also involved the collection of motivation assessments and reinforcement assessments currently being used in education or the workplace. For example, the Dunn Rankin (Cartwright and Cartwright 1970;

Landschulz 1978) is a commonly used reinforcer inventory in schools (Landschulz 1978) and the Work Preference Inventory (Amabile et al. 1994) is one used in employment. In Task 2, the first iteration of the MAT and a motivator taxonomy were developed to identify and define interrelations between motivation and personality traits, which will later be used to prescribe adaptations within GIFT to support the learner's motivation traits. Task 3 involved documenting outcomes from the design of the motivational trait variable definition and MAT classifiers within this report.

2.1 Task 1: Data and Application Assessment

Task 1 began with a literature review that required scoping the macro and micro issues pertaining to the topic of motivation and their relevance to specific aspects of other individual differences and the impact on learning. The literature review provided the foundation to construct the MAT and classifiers (Appendix A). Two themes emerged from the literature review. First, the topic of motivation is immense and complex (Alderman 2013). Many of the variables were classified as separate entities, but had distinct parts of commonality among them. To develop a pedagogical approach for providing adaptations within GIFT to support the individual learner's motivation, an ample picture of an individual's motivation, provided from an inclusive assessment, encompassing a multitude of motivational variables, is required. This is crucial, because the ITS needs to create a relationship with the learner and provide the perfect fit. Motivation is inherent to a learner, and thus, present prior to completing a training session. However, motivation can be enhanced or hindered throughout the training process. Therefore, personalization within GIFT is necessary to deliver and maintain motivation, adapting for optimal learning. This theme also indicated that motivators will need to be delivered according to a schedule based on individual needs that allows motivation to be maintained throughout a learning task.

The second theme was that for each variable included in relation to motivation, an added layer of interactions and complexities results. A reinforcer is the stimulus in the form of a reward or incentive that is received following a desired behavior that accomplishes the goal (French 1955; Keller 1987a). The term reinforcer was operationalized to motivator because it is not reinforcing a behavior, but proactively using tools to increase learner motivation. A motivator might be more than a reward or incentive, for example, as a level of autonomy, frequency, or stimulation. This left the possibilities endless. To reduce the set of specific motivators for use in GIFT, a list from games, workforce, and education was compiled for the comprehensive list. The collaborative team discussed the list and whether GIFT was capable of supporting each motivator. It was noted that some motivators are

supported without an instructor-like digital tokens, whereas others require an instructor, such as food. An additional consideration for inclusion of the motivator into the final list was its relevance to military training tasks. Motivators that are relevant to a military task might be a timer, leaderboard, motivational quotes, tokens, and feedback. Motivators not relevant to a military task include bubbles, playdough, and a sticker.

This literature review provided a goal for the MAT development, such that the MAT should enable properly individualized motivators to be determined from a multitude of variables and those motivators should then be able to be adapted in an ITS. The Assessment Framework as outlined in Goodwin et al. (2015) provides an overview of different types of assessments in GIFT. The MAT falls under the pre-training assessment that is content independent based on aptitudes and traits with macro-adaptations (Fig. 1). It is envisioned that the learner will take the MAT prior to training with the results being stored in the LTLM so that the learner does not need to complete the MAT prior to each training session. It is based on motivational traits and not a person's states in the form of a questionnaire. Since it is not content related, it will affect the training delivery, but not the content itself. However, it should be noted that the learner plan (explained in Task 4) will provide a pretraining assessment that is content dependent and will be used to adapt flow through content based on the learner's grasp of the preassessed content knowledge. The image in Fig. 1 displays the assessment being used and the timeframe in which it will be delivered.

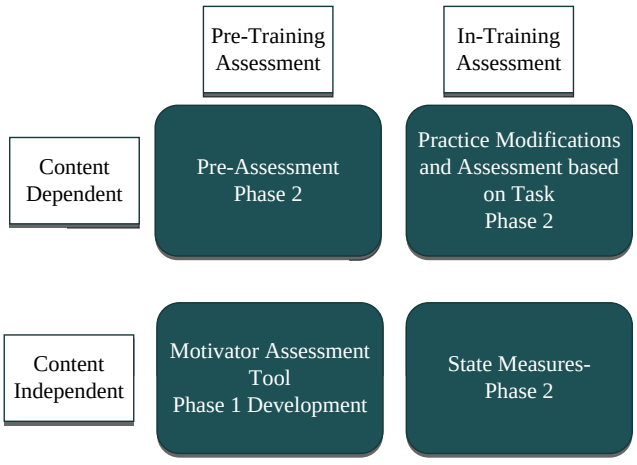

Fig. 1 MAT placement in GIFT framework

2.2 Task 2: Motivator Assessment Development

Task 2 discusses MAT development. Cronbach and Meehl's (1955) 3 requirements for scale and assessment creation were considered for validity and reliability in

developing the MAT: 1) articulating a set of theoretical concepts and their interrelations, 2) creating a way to measure the constructs to be evaluated by the MAT, and 3) empirically testing (Phase 2) the hypothesized relations among constructs. This section captures the process and reasoning behind the prototype of MAT. An iterative cycle occurred in developing the MAT such that an initial MAT layout was designed from the literature review. Based on that design, criteria for operationalizing variables of motivation that impact corresponding motivators were determined. The resulting definition and scope led to the creation of a motivator taxonomy, whereby all variables were documented, organized, and categorized. The taxonomy fed back into developing the MAT, but was also refined as MAT development advanced.

2.2.1 Motivator Variable Definition

At the outset of the project, motivation was originally thought of as a state. Given that the project focus is to develop a motivator taxonomy, which describes the interaction of a learner's motivation tendencies over time and targeted strategies to support the learner's motivation, the term trait was deemed more appropriate. Learner motivation comprises several traits, which are variables that influence the learner's motivation and its resulting impact on learning. When the variables are linked and accounted for, they make up a more complete description of an individual's motivation. Variables that contribute to an individual's motivation include personality (Goldberg 1981; Dingman 1990); grit (Duckworth et al. 2007); procrastination tendencies (Lay 1986); intrinsic versus extrinsic motivation (Ryan and Deci 2000); task interest, autonomy, or level of learning control (Rotter et al. 1972); self-esteem (Rosenberg 1965); self-efficacy (Bandura 1977); goal orientations and tendencies (Elliot et al. 2011); student approaches to learning (SAL; Bigg 1987); knowledge level, sensitivity to punishment (conflict resolution), and reward (Gray and McNaughton 2000); values (Schwartz 1992); self-regulation (Bandura 1991); and learning styles (Felder and Silverman 1988). When the motivators are provided to learners, they are affecting their motivational state.

Not all of the variables are traits, some are external influences that affect the motivational state. GIFT is able to adapt based on knowledge level, which is an example of an external influence of motivation. Humans are multifaceted; therefore, the motivation trait variable definition needs to encompass as many differences found that apply to motivation. Figure 2 depicts each of the variables currently assumed as a learning motivation characteristic.

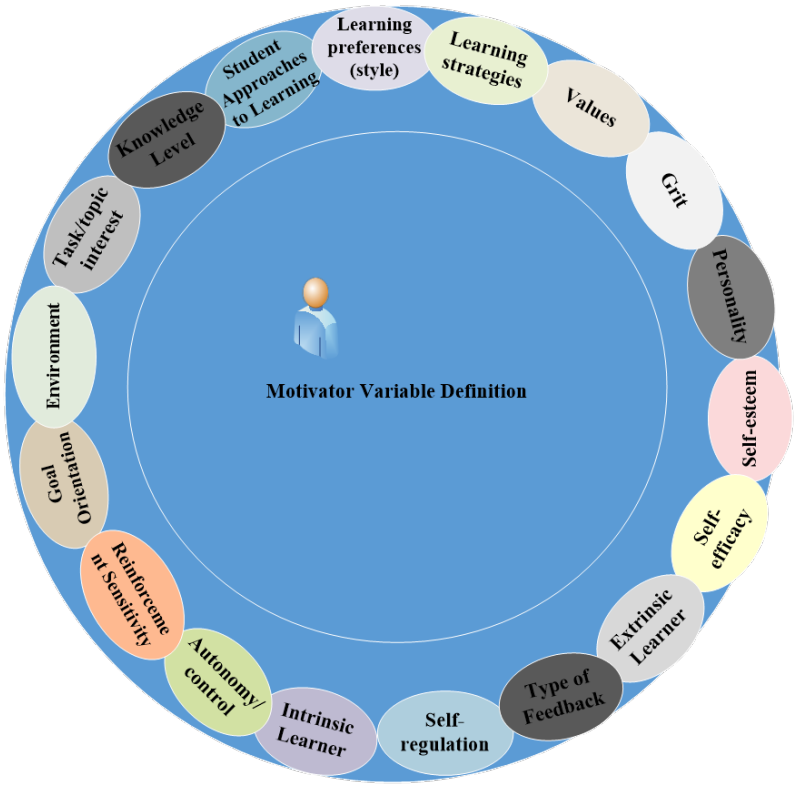

Fig. 2 Motivator variable definition graphic

2.2.2 Motivator Assessment Taxonomy

The literature review completed under Task 1 identified theoretical motivation constructs and variables. Those variables were organized into the motivation taxonomy, where interconnections were observed. For example, learners with intrinsic motivation are more likely to have a high level of conscientiousness from the Big 5 Personality model and tend to have a higher level of grit (Duckworth et al. 2007). Research of these interconnections suggested that personality trait identification may be relevant to individualizing pedagogy to support the individual learner's motivation. This means that personality traits may be useful for determining the level of support a learner requires and the frequency at which motivators should be presented (Kyllonen, Shute 1989; Busato et al. 1999). Lameier et al. (2017) detail the interconnectedness of pertinent motivation variables and the steps for creating the MAT. All the background data pertaining to motivation and individual differences described in that paper provided the foundational work needed for creating the assessment. The construction of the assessment was discussed, but does not provide a detailed description of the process. This report extends that initial work.

A tailored pedagogy is needed to support the learner throughout the entire learning experience. Therefore, the MAT would serve that purpose by identifying a learner's motivators for implementation throughout the learning experience. The first step was to compile existing assessments used for the variables of personality and motivation that pertained to learning. This led to 31 assessments reviewed.

Only a few assessments, such as The Motivated Strategies for Learning Questionnaire Manual (Pintrich et al. 1993) and the Adaptive Patterns of Learning (Midgley et al. 2000), provide an assessment of a broader scope of motivation by addressing more than one motivation trait variable. To begin identifying the interconnections within these various assessments and reduce the number of overall questions, the questions from each of the assessments were typed up and color-coded. The color-coding was associated with the assessment from which the question came and aided in organization when the questions were moved to reflect various connections. Figure 3 provides some of the assessments and associated questions that were compiled, their color-coding, and typed listings.

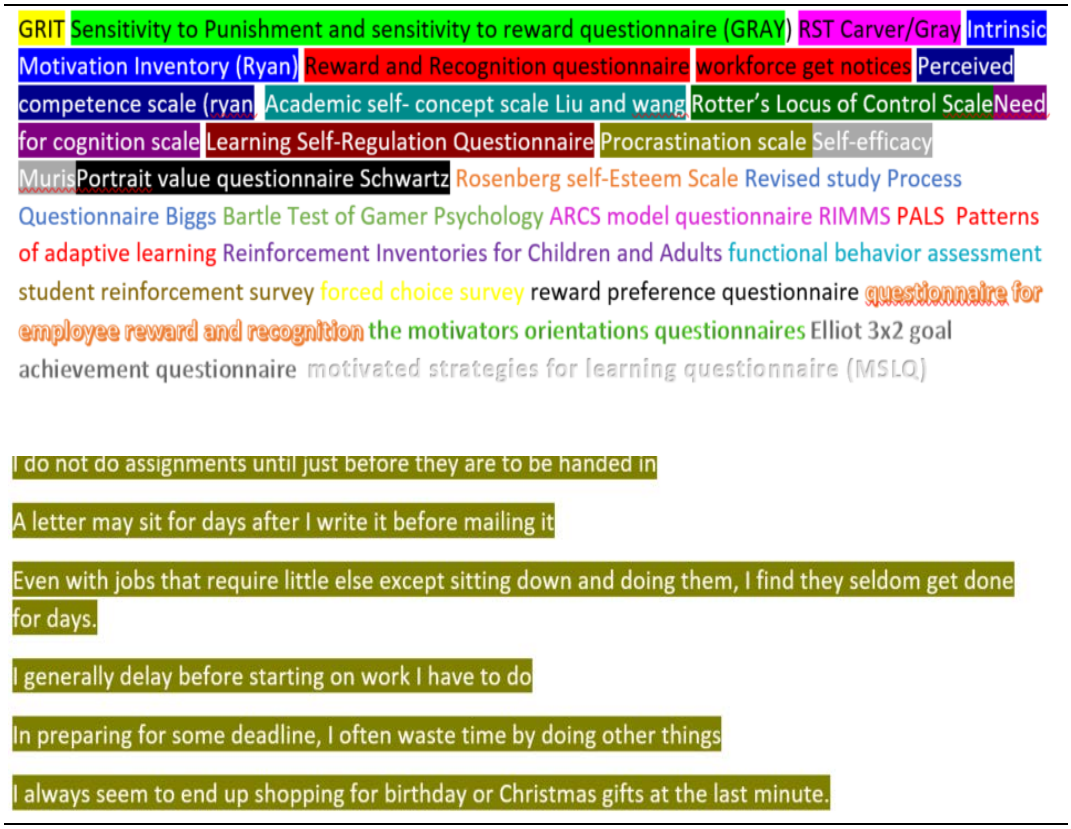

Fig. 3 Examples of the assessments compiled and associated questions

Similarities within the questions of the assessments were documented. Then, the questions were rearranged into clusters of similarity. Some noted similarities were avoidance, worry, giving up, boredom, hard work, success, persistence, and comparing and contrasting to others. However, as the questions were rearranged, connectedness between groupings remained. The questions were regrouped until the clusters were considered relatively distinct. Personality types were also taken into consideration while grouping the questions. For example, if a learner is worried, avoids, or has a high stress level, then that section of MAT questions would possibly tailor to a person who is high on the neuroticism scale. It may also correlate with a learner who is high on the conscientiousness scale because their need for detail and achievement could cause them stress. The difference is persistence. Conscientious learners are correlated with grit and self-efficacy on the topic, which determines if they are going to avoid or persevere based on experiences of success with the topic.

Assessment items were discarded if they would not apply to the ITS. The following are examples of the questions that were discarded:

1) Do you often meet people that you find physically attractive?
2) Is it easy for you to associate taste and smells to pleasant events?
3) One of the major reasons why we have wars is because people don't take enough interest in politics.
4) There will always be wars no matter how hard people try to prevent them.
5) I would run quickly if fire alarms in a shopping mall started ringing.
6) I would leave the park if I saw a group of dogs running around barking at people.

Next, the number of questions were reduced by eliminating redundant questions. Some questions were rewritten to make sense in the context of an individual student learning within GIFT. Finally, similar questions were collapsed into their basic concepts, which lowered the overall number of questions. This first reduced-question set provided approximately 434 questions, without inclusion of the reinforcer inventory. Figure 4 shows a sample of the questions from the first reductions.

Avoidance/ Stress/ Worry

1. I try to avoid participating in class. (PALS)
2. I avoid complex task because I may not be successful providing correct answers. (complex, Elliot)
3. I avoid situations that requires in-depth thinking. (need for cogn)
4. I avoid task in order to not be rejected or disapproved by others. (sen to pun)
5. I work hard to avoid doing worse than I normally do on task/exams. (PALS)
6. I want to avoid becoming embarrassed (sen to pun)
7. I like to avoid appearing that I am not having trouble with the task (PALS)

Fig. 4 First reduction questions

The resulting items were still linked to the applicable motivation trait variables. After removing additional similar questions, the total number of items was reduced to 190 questions. The categories were no longer in order by variables because of their connectedness. The order became a flow of the processes the ITS would use to tailor the learner's pedagogy based on item responses. Processes flow from "a" to "h", whereby at each level, a different categorization is identified:

a) Identified interest in the topic,

b) Identified tendencies for intrinsic or extrinsic motivation,

c) Identified level of effort the learner is comfortable extending for gaining feelings of satisfaction,

d) Identified emotional influences,

e) Identified task selection and goal orientation,

f) Identified learning strategy preferences,

g) Identified learning environment preferences, and

h) Identified reward orientation and motivator inventory.

This flow became the organization for the motivator taxonomy (Fig. 5). The taxonomy enables a quick glance of the key variables of motivation. The details contained within are a mapping of the questions to the broader constructs associated with motivation.

Category	Item	How will this information	Linkage from original	E	N	O	C	A	Grit	Intrinsic	Autonomy	Self-esteem	Self-efficacy	Goal	Learning preference	Predisposition	Reward	Values	Task Interest	Self-regulation	preference	Need for	Gender	Age Range	Income Level	Education Level of	Hours of sleep	Area you live in	GPA
Effort	My goal, when taking a course, is to provide the correct answers.	task approach 1&3	3x2			1	1					1		3														
Effort	My goal, when taking a course, is to understand the material as well as getting the questions	deep and strategic	value-achievement, achiev	1		1	1		1	1					1							1				2,3,4			3
Effort	I will not give up and will continue to strive for understanding, no matter the complexity of the material.	Not give up less motivation	Grit, MLSQ, Complexity, acade		2		1		1	1		1	1		1					1		1				2,3,4	3		3

Fig. 5 Image of motivation taxonomy organization

The set of 190 questions did not address the learner's task and presentation preferences, so questions were created to fill this gap. These additional questions included items of presentation style choices, modality preference (e.g., visual versus audio presentation), and strategies needed to learn. Items pertaining to preferences on rewards were placed in a reward orientation section that contained a broader scope of motivators such as preference for acknowledgement, rewards, feedback, and competition. The more specific motivators were consolidated in a motivator inventory. This inventory is envisioned to provide a set of reward types that will be the most beneficial in terms of supporting the learner's motivation.

The taxonomy documents the interconnections of each item to the personality, motivation, and demographic variables identified in prior research and estimates from our understanding of the research. The taxonomy shown in Fig. 6 was also used to 1) make sure there was an adequate amount of questions for each variable and 2) balance the number of pro to con statements. The taxonomy is available upon request.

Pro 1	Emotional	It's ok to make a mistake because it a part of	type of mindse	me minds	1	2		2					1	1			1													
Con 1	Emotional	Thinking about mistakes makes me worry.	growth mindse	(RST)		1		1					2	2			2									3,4				3
Con 2	Emotional	I often worry about not meeting others standards.	remain unkno	(RST)		1			2				2				2													3

Fig. 6 Pro and con matching

Each of the remaining items were then linked to the motivation-trait variable addressed based on the results of the prior research reviewed. A coding legend was created to describe the connection to each item and the applicable motivation trait variables, as shown in Fig. 7.

Personality Variables	1 if link to someone with high trait, 2 if linked to low trait, 0 if no link
Grit	1 if linked to high grit, 2 if linked to low grit, 0 if no linkage
Intrinsic vs. Extrinsic	1 if linked to Intrinsic motivation, 2 if linked to extrinsic motivation, 0 if no link
Student Autonomy	1 if linked to perceived or actual control of learning, 2 if linked to lack of perceived or actual control of learning, 0 if no link
Self-Esteem	1 if linked to high self-esteem, 2 if low self-esteem, 0 if no link
Self-efficacy	1 if linked to high self-efficacy, 2 if low self-efficacy, 0 if no link

Fig. 7 Example of the coding legend

A definitions page was also created to establish the definitions of each motivation trait variable. See Appendix B for definitions of the motivational trait variables.

The MAT consisted of the questions organized in the motivation taxonomy. Directions were then added to the MAT so that it could be administered in a survey to enable its validation. These directions took into consideration that people do not always answer surveys honestly (Bandura 1997; Scandell et al. 2000). The directions clearly stated that this assessment is only to be used by the ITS to provide the individual with a motivator plan tailored to individual motivation preferences.

Scales were created for the MAT survey. The collaborative team discussed reasons for different points of scales, with 5- and 7-point scales being the focus. Research in this area is mixed. Spagna (1984) found that without the midpoint, the results had an increase on the other scale responses. Dawes (2001) found that having a midpoint reduced the amount of positives. Garland (1991) found that having a midpoint reduced the amount of negatives. Many of the motivational scales previously published employed a 5- or 7-point scale. There are also mixed reviews between 5- and 7-point scales. Generally, the 7-point scale is found to have a slight increase compared to the 5-point scale (Diefenbach et al. 1993). Miller (1956) found that humans can distinguish 7 different items. It was also taken into consideration that many individuals will not pick the extremes of a scale. The 7-point scale allows individuals to admit to something without admitting to the extreme. An even-numbered scale was selected to provide a forced-choice scale that eliminates a middle choice, such as neutral or not applicable. The scale development was the final piece in creating the prototype assessment. The prototype of the MAT assessment can be seen in Appendix C. This prototype is a large pool of questions that will be refined and reduced through a rigorous validation process.

The MAT will result in identification of a category of motivators best suited for that learner. This will occur by a means of aggregation of scores that will be determined following validation of MAT items.

2.3 Task 3: Experimentation in GIFT and Analysis Plan

The first step for validating the MAT was to identify the correct assessments to evaluate against. The second step was to divide the assessments with the MAT into 3 waves of experimentation, whereby the MAT would be reduced and refined following each wave. The third step was to enter the MAT and the identified assessments into GIFT Cloud for administration to as wide of a population as possible using both Amazon Mechanical Turk (MTURK) and the UCF Sona System. Finally, an institutional review board (IRB) proposal was submitted and approved.

The first step of reducing and refining the MAT was inserting it into GIFT. To do that, all experimental questions were typed into Qualtrics and then uploaded into GIFT Cloud. The MAT was broken down into 3 sections. A pilot survey was conducted to develop a sense of time required for participants to complete. The results of the pilot survey showed that the amount of questions in the sections were too long. The team provided feedback to break the assessment down further to provide the participant short breaks. The MAT was broken into 7 sections: 5 sections on general motivation variables and 2 sections for the reinforcer inventory. Page numbers were also added to let the participant know the length of all the assessments.

Wave 1 involves only administration of the MAT (Fig. 8). This is the first time the 190-item motivation assessment with the 102-item motivator inventory is presented to participants beyond the project researchers. The MAT was entered into GIFT in several different ways, but due to the sheer number of items, ultimately it was broken into 7 sections, 5 for the motivation variables and 2 for the motivator inventory. The purpose for this wave is to execute an item analysis for internal consistency and for face and content validity. Internal consistency is a type of reliability that addresses agreement among items within a questionnaire that are intended to measure the same construct. For Wave 1, this answers the question, do the items that are intended to reflect each variable (e.g., extraversion or grit) produce the same type of response from the participant, so that the items "hang" together? Face validity is the degree to which the measure appears to measures what it is intended measure. For Wave 1, this answers the question, does the MAT feel like it evaluates motivation? Content validity addresses the extent to which a measure includes all of the facets of a given construct. For Wave 1, this answers the question, does the MAT include all the correct variables of motivation and motivators?

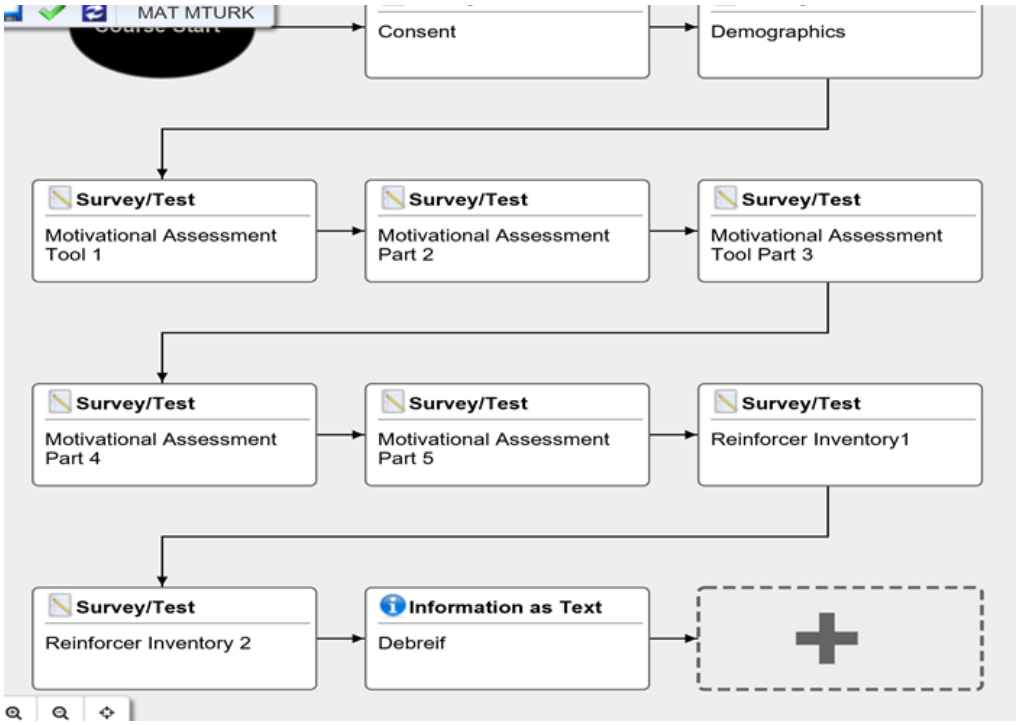

Fig. 8 Wave 1 in GIFT

Two hundred participants will be run in Wave 1 and each participant is expected to take 1 h to complete. After it is administered and analyzed, the MAT will be refined and reduced. For example, if all the participants select neutral, then the question would be eliminated or reworded.

As with Wave 1, Wave 2 will be executed using GIFT. The MAT and selected motivation variable assessments are included in this wave to evaluate content and construct validity. Construct validity addresses whether a measure assesses what it is intended to assess and can be further divided into convergent and discriminant validity. Convergent validity refers to the degree to which 2 measures of constructs that should relate, actually do. For example, in Wave 2, items that should be measuring grit in the MAT strongly correlate with the grit and ambition short questionnaire. Discriminant validity refers to the degree to which 2 measures of constructs that should not relate, actually do not. For example, in Wave 2, items that should be measuring grit in the MAT do not strongly correlate with a need for cognition. Wave 2 is also designed to establish reliability of the MAT. A document was created to show the construct alpha correlations. A Cronbach's alpha coefficient that is close to 0.7 and above indicates the assessment items provide acceptable measures (Gliem and Gliem 2003). Table 1 presents the Cronbach's alphas for each of the established assessments being compared with the MAT.

Table 1 Cronbach's alphas from assessments being compared to MAT

	Motivation Intrinsic 0.74 Extrinsic 0.62 Task value 0.90 Self-efficacy 0.93 Control of learning beliefs 0.68
Motivated Learning Strategies Questionnaire (MLSQ) (Pintrich et al. 1993)	Learning strategies, MLSQ strategies Self-regulation, cognitive metacognitive rehearsal - 0.69 Elaboration 0.76 Organization 0.64 Critical thinking 0.80 Metacognitive self-regulation 0.79 Resources management: Time study 0.76 Effort regulation 0.69 Peer learning 0.76 Help seeking 0.52
Neo International Personality Item Pool (IPIP) 120 (Johnson 2014)	**Neuroticism** - 0.90 • Anger 0.87 • Anxiety 0.78 • Depression 0.85 • Self-consciousness 0.74 • Impulsiveness 0.72 • Vulnerability 0.76 Extraversion- 0.89 • Warmth 0.81 • Gregariousness 0.79 • Assertiveness 0.85 • Activity 0.71 • Excitement-seeking 0.77 • Cheerfulness 0.80 Openness to experience 0.83 • Imagination 0.76 • Artistic interest 0.76 • Emotionality 0.69 • Adventurousness 0.72 • Intellect 0.75 • Liberalism 0.64 Agreeableness 0.87 • Trust 0.86 • Morality 0.76 • Altruism 0.76 • Cooperation 0.73 • Modesty 0.76 • Sympathy 0.72

Table 1 Cronbach's alpha from assessments being compared to MAT (continued)

Neo IPIP 120 (Johnson 2014)	Conscientiousness 0.90 • Self-efficacy 0.63 • Orderliness 0.83 • Dutifulness 0.69 • Achievement striving 0.80 • Self-discipline 0.73 • Cautiousness. 0.87
3 × 2 achievement (Elliot et al. 2011)	Task-approach goals 0.84 Task-avoidance goal 0.80 Self-approach goals 0.77 Other-approach goals 0.93 Other-avoidance goals 0.91
Carver White behavioral inhibition/ avoidance scale (BIS/BAS) (Carver and White 1994; Gomez et al. 2005)	BIS 0.74 BAS Reward responsiveness 0.73 BAS Drive 0.76 BAS Fun seeking 0.66
Self-esteem (Rosenberg 1965; Tafarodi and Swann 1995; Robins et al. 2001)	Alpha reliabilities for the 5- and 7-point versions, respectively, were 0.89, 0.93 for the RSE; 0.72, 0.79 for the SDE; and 0.78, 0.78 for the IM.
RR-portrait value Schwartz (Schwartz and Butenko 2014)	Self-direction thought 0.72 Self-direction action 0.75 Stimulation 0.82 Hedonism 0.84 Achievement 0.86 Power dominance 0.88 Power resources 0.79 Face 0.85 Security personal 0.71 Security-societal 0.89 Conformity-rules 0.94 Conformity-interpersonal 0.89 Tradition 0.89 Humility 0.81 Benevolence caring 0.89 Benevolence dependability 0.85 Universalism tolerance 0.83 Universalism concern 0.82 Universalism nature 0.92
Revised study process (Biggs et al. 2001)	Deep approach 0.80, 0.70 Deep motive 0.62, 0.58 Deep strategy 0.63, 0.54 Surface approach 0.76, 0.62 Surface motive 0.72, 0.42 Surface strategy 0.57, 0.53
Need for cognition (Sadowski 1993)	18 items short 0.86
Grit, ambition (Duckwork and Quinn 2009)	0.73–0.83

To note, originally the portrait value questionnaire was going to be used. However, much of the research stated that it was for children and adults that did not like to think abstractly. Most of the research pointed to the Schwartz value survey but, it could not be found. So, Dr Schwartz was contacted to find the form. He said that he had not used the survey in 10 years and sent us the new survey based on a refined and revised portrait value questionnaire (Schwartz et al. 2016). This revision expanded the original questionnaire into 19 values for greater predictive power and heuristics (Schwartz and Butenko 2014).

Two hundred participants will be run in Wave 2 and analysis will be an exploratory factor analysis. A factor analysis processes the data to determine correlations or clusters of items, called factors, which will hopefully reduce the number of items in a measure (Child 2006). However, no items will be eliminated prior to completing Wave 3.

Wave 3 will include the MAT and the IPIP (Johnson, 2014) to check reliability content construct validity. Approximately 200 participants will take a variation of the 3 different courses for Wave 2. Like Wave 2, Wave 3 will be subjected to exploratory factor analysis. On the basis of the results from both Waves 2 and 3, the MAT will undergo a final reduction in items.

2.4 Application of MAT in GIFT

The current flow of adaptations in GIFT follows a route from the actionable survey, to the learner model, to the pedagogical model, then the course adaptation (Fig. 9). The actionable survey is scored based on the tags attached to the concepts addressed by the individual survey questions. The logic is written into the survey for scoring. The information collected from the survey is sent to the learner model (found in advanced settings) and the scores for the concepts are updated. The scores are then used to classify the learner as a novice, journeyman, or expert for each concept that the survey tested. After the concept is scored and classified, it transfers the information on the individual to the pedagogical model sets' metadata attributes to adapt the difficulty level of the content based on their level of expertise classification for the associated concept. The rule is created and applied into different parts of a lesson based on the application of Merrill's Component Display Theory (Merrill 1983). These rules are then placed in the adaptive course flow. The data are collected in the Learner Record Store (LRS). A learner profile that provides students information if they passed or failed the course is created by pulling the data from the LRS.

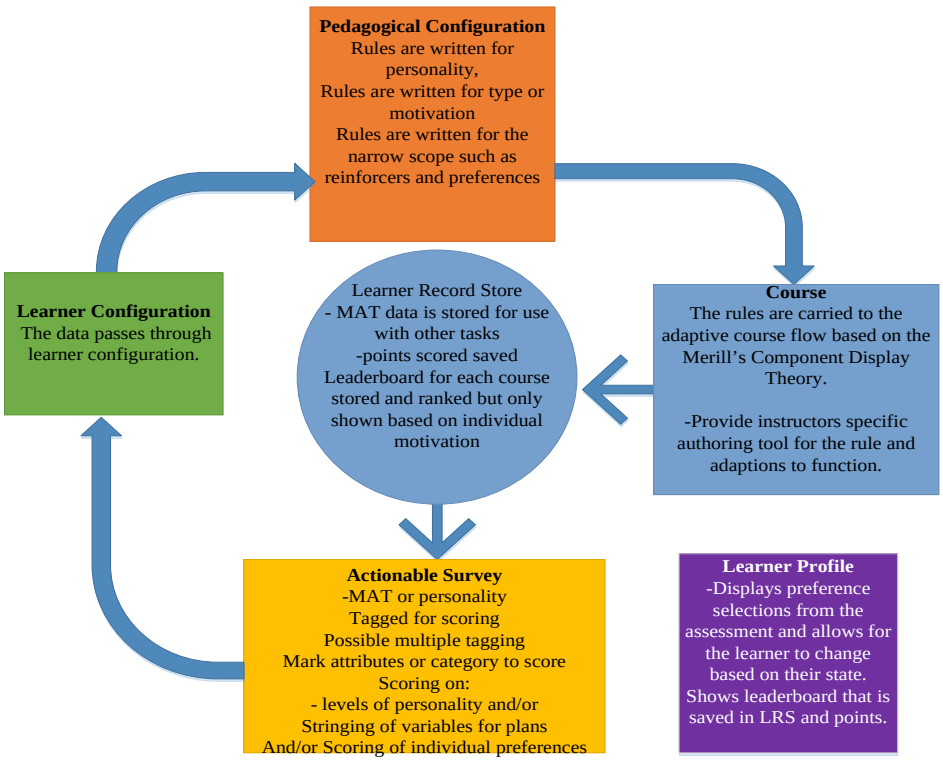

Fig. 9 MAT's integration in GIFT

For this project, the MAT will be implemented as an actionable survey. Mapping the MAT into an actionable survey will flow into this same cycle, but the resulting adaptations will be designed to support the learner's motivation. Figure 9 shows the added pieces for the flow and an explanation of the MAT into GIFT.

2.4.1 Learner Record Store

The MAT results will need to be stored in a LRS, which we are assuming will be the component that stores the LTLM. If a learner takes a questionnaire prior to a task every time, their motivation will be depleted. This is consistent with the goal of the LTLM to have a historical learner model that contains learning experience historical data, as well as data pertaining to individual differences in learning that may be used to tailor the pedagogy and delivery mechanisms. The learner should need to retake the assessment after a period of time, such as a year, or after major life events that could jeopardize the stability of the trait. The person could retake it at any time if they feel the plan is not right due to not answering honestly or a major life event. Some of the information should be shown to the learner on the profile where the course history is kept. Learners should be able to view and verify the specific preferences that have been selected for them. They should be able to change a preference if their state is discordant with their trait profile due to activity just prior to their learning session. For example, if there is a learner scoreboard, the

data will need to be calculated and sent to the learner record store where it 1) compiles other student's points and 2) places the results, in order of highest to lowest, on the learner scoreboard.

2.4.2 Actionable Questionnaire of MAT

The final state of the MAT will be shaped by the results from the verification experiment. The assessment will then be mapped into an actionable questionnaire. Currently, the MAT is divided into sections based on groupings the ITS would need to know such as intrinsic motivation, level of effort, affective tendencies, comparing/competitiveness, task (preference and strategies), reward orientation, and reinforcer inventory. Extrinsic tendencies will be scored from the reverse of the intrinsic tendencies. If the results of the MAT evaluation show a high correlation between intrinsic motivation and other motivation traits or even personality traits, then it may not be necessary to assess all of the individual motivation traits. This would greatly simplify our model, assessment, and approach. However, if the correlations are not that strong, then it will be important to identify each of the separate traits and have logic for handling various combinations of the traits. For example, it is expected that personality trait data may contribute to the identification of extrinsic motivation, but needs to be confirmed as part of the verification experiment data analysis.

The vision is that each of these sections can be scored to identify the level or existence of each of the motivation traits. The scores for these traits will be made actionable by having specific delivery and pedagogy preferences associated with each trait, as well as combinations of multiple traits since there are expected interrelations among the motivation traits, personality traits and demographic variables. A tag will be set to score the various sections from the actionable survey (experiment dependent). The assessment might be able to score on multiple levels, such as a general level that would classify a learner as having intrinsic or extrinsic motivation, as well as narrow levels, such as classifying a learner as having an introverted personality trait and extrinsic motivation. This may call for a different way of scoring the assessment and a different tagging system. Current capabilities of GIFT allow for one tag to an attribute per question. For different types of learners, certain questions may be used for more than one score. For example, Tag 1 would be scored with the Intrinsic Learner Plan such that an intrinsic learner's correlates are with a set of variables that need to be scored throughout the assessment and not just based on a few questions measuring one attribute. Tag 2 might be with the Extrinsic Learner Plan such that the extrinsic learner will need to provide the personality type. Tag 3 might be with Personality Type, which is needed to further guide the extrinsic learner plan to accurately provide the type of schedule,

level of support needed, and so forth (yet to be determined based upon the Wave 1–3 results). A separate tag might not be needed if the item is specific to only intrinsic or extrinsic learners. Therefore, the MAT will be tailored to motivation such as a type of general plan down to the more narrow strategies and preferences a learner needs for them to learn optimally. For the ITS to have a complete picture, it needs to be provided as various levels of information.

Based upon the results from Waves 1–3, a different path for mapping individual differences into training and strategies might occur. Rules might be written for different sections of the assessment to provide different things for the learner (Table 2). The comments are anticipated to begin tagging people based on what is known from personality or intrinsic/extrinsic learners. The rule is the way in which a tag might be implemented in a GIFT course.

Table 2 Example of rules from MAT

Section	Statement	Comments	Rule
Intrinsic	I need to feel in complete control, over my learning.	This is intended for scoring an intrinsic learner plan seen below. However, intrinsic tendencies are also found in personalities such as openness. (Entwistle 1988)	If a person scores high in the intrinsic or personality then they will be able to make decisions to change the pathways of their learning as seen in the intrinsic learner plan. Rule: Apply plan with maximum autonomy and choice.
Effort 1	I like to delay my work, until it is necessary.	Delaying work is associated with specific personalities such as ties to neuroticism (Watson 2001) if avoiding the task because they do not feel they will be successful. A person who is conscientious should score reversed on this question because of the negative link to procrastination found in research. Low conscientiousness might need the reminders to begin because of the level of focus and impulsiveness. This is an extrinsic learner so the score would be factored into the different plans.	If the individual scores higher (most individuals will not honestly pick the extreme) on this question: Rule for this learner: Motivation will begin prior to the task. Such as a quote, music, physical activity, or animation. (reinforcer inventory) Praise can also be provided to the learner in the form of supportive empathetic reminders. (reward orientation and reinforcer inventory) Added points for starting the task on time could be provided to the learner to increase the chance of starting right away on other tasks. (reinforcer inventory)

Table 2 Example of rules from MAT (continued)

Section	Statement	Comments	Rule
Effort 2	I can pass by memorizing the information, even if I do not understand the material.	This person is a strategic and extrinsic learner. For personality they give up easily or have had prior success toward this type of learning. If it is extrinsic, assumptions could be made on the type of personality this would tie to. A person who has a fear of seeking help, possibly an introvert. Doesn't want to look stupid to peers and avoid failure such as a neuroticism. Or someone who has a low level of patience and focus such as low conscientiousness.	This person would need to begin the course at a lower complexity to ensure success and being proactive on limiting their chances on not understanding. This type of person needs more examples, scenarios, and/or forced reflections with the content. Providing more examples forces them past the memorization. Questions at a higher level of Bloom's would also allow the ITS to see that the student cannot apply the information but just spit it out.
Emotional Influences 1	Thinking about mistakes makes me worry.	Ties to low self-esteem, low self-efficacy, neuroticism, possibly high conscientious-ness, strategic learner, and, Sensitivity to Punishment.	This person needs a supportive plan. They need to begin at a lower complexity and move to a higher. The practice level needs to begin at the demonstration level, guidance, and then individual. When getting a wrong answer the feedback needs to be supportive and empathetic with a quote about growth mind set on the mistake. Example: I am glad you made this mistake. Remember it helps you grow. You are making progress in learning! Let me demonstrate and explain this question. Now you correct your mistake to prove to yourself you learned. After they rework the question: Excellent accomplishment. Here is a bonus 200 for progressing further toward your goal with persistence.

Table 2 Example of rules from MAT (continued)

Section	Statement	Comments	Rule Example
Ranking 1	I like to compare myself to others in an anonymous manner.	This individual has ties to introverts. If they like to compare to others the question has ties to extrinsic. They are sensitive to their social image.	Rule: Show leaderboard of points with a fake name.
Ranking 3	Being compared to others is something I detest.	This individual also has ties to an introvert and neuroticism but at a different level from the question above. The impact of having comparisons could cause this learner to shut down.	Do not rank show the individual the leaderboard. No competitions on a task or assessment.
Task/Strategy	I prefer to write my own goals.	This is only given to an intrinsically motivated person because they are already deep level learners and strive for maximum understanding. Openness is associated with intrinsic learners.	Rule: Provide the learner the option to write their own goal if an intrinsic learner or the personality that correlates with intrinsic learning.
Task/Strategy 2	Helping me manage my time will reduce "off task" behavior.	This would help impulsive learners that have a difficult time staying on task. Special education teachers provide buzzers to help learners self-regulate their time off a task. This question will also related to brain breaks. Learners who are more impulsive benefit from more frequent brain breaks.	Rule: A time schedule to set reminders for the learner. This could be a short brain break with physical movement re-set the mind.
Reward Orientation 1	My satisfaction increases, when I receive points and feedback on my accomplishments.	Extrinsic learner plan. Personality would be dependent on schedule example neuroticism would need this more frequently.	Rule: Provide points and feedback on accomplishments based on personality schedule. Neuroticism: Provide after every item for points and feedback after every 3–5. Conscientiousness: After a successful completion of a subtask in the course.
Reward Orientation 2	I would rather not receive a reward.	A intrinsic learner would not care if they received a reward. Accomplishment is their reward.	A surprise reward unrelated to the task but not every task.

2.4.3 Course Adaptations

The rules created from the MAT might be sent to the various parts of the Merrill's (1983) component display module for adapting the course. The course itself will need new tools to provide the author. Further discussion on the course adaptations provided follow.

3. Task 4: Design Ideas for Phase 2

Manipulation of instructional strategies targeted to optimize the motivation traits described previously might influence the learning rate and retention of a task. The complexity of the design for providing an instructional strategy within GIFT that is tailored to these individual differences requires extensive and fine-grained planning. To measure effects between the different tailored instructional strategies requires a control version, which does not have any tailored strategies. The first instructional strategy variable to be tested is the level of control provided to the learner and the resulting autonomy provided to the learner. Based on the prior sections, the optimal level of control, perceived autonomy, and motivator preference is based on the learner's motivation type (intrinsic vs. extrinsic), achievement goal disposition, affect, general self-efficacy, and personality. This variable will have 2 manipulations in our planned experiment: one in which the control level is appropriate given the learner's MAT results and a yoked manipulation in which the level of control is discordant with the learner's MAT results (yoked condition). The following sections describe initial ideas for the design of learning strategies. These ideas are contingent upon the MAT validation results from the waves.

3.1 Background for the Learner Plans with Personality Traits

Research has provided evidence that some personality traits are associate with increased academic motivation (Komarraju et al. 2009). The following discussion on personality is based on the use of the Big 5 Personality model described previously, with the traits of extraversion, neuroticism, openness, agreeableness and conscientiousness. This comparison builds an extension of motivation. The personality traits of conscientiousness, extraversion, and openness appear to have the strongest goal orientation (Payne et al. 2007). Individuals who have high neuroticism and low extraversion are more prone to fear of failure and avoidance (Payne et al. 2007). Neuroticism is negatively related to the theories of goal setting, expectancy theory, and self-efficacy theory, where conscientiousness was positively related to all 3 (Judge and Ilies 2002). Therefore, the optimal level of

support and timing for an individual may be dependent on their personality trait composition.

For example, the conscientious learner is driven by achievement; therefore, motivation does not need to occur from the very beginning of the course. Given this drive for achievement, it is important that they are provided with feedback for correct and incorrect answers. Since they are sensitive to punishment, feedback for incorrect answers will aim toward learning and not be administered in a punitive manner. Conscientious learners also prefer feedback regarding their long-term effort. Since conscientious learners value achievement, they can handle a more challenging task and persist for a longer period of time. Therefore, if the conscientious learner is provided an external motivator, its recommended implementation is to stretch it out over time. For example, tokens would be provided in larger quantities over a longer period. If the MAT validation waves demonstrate that intrinsic motivation is related to high conscientiousness and openness, but low neuroticism, then this would indicate that they do not need motivators.

3.1.1 Conscientiousness and Motivation

Learners that score low in conscientiousness are more likely to procrastinate (Steel 2007). They are linked to impulsivity and carelessness, impatience, and distraction (Cheramie and Simmering 2010). Cheramie and Simmering (2010) found low conscientious learners need higher accountability for higher learning outcomes. These can be stimulated to higher levels of learning. Learners need to be motivated from the beginning, even before the lesson begins. The feedback needs to be more tailored to staying on task and effort. This type of learner needs to play a more active role in learning. They need to be constructing and not just soaking in the information.

3.1.2 Openness and Motivation

Learners with high openness tend to have more interest, creativity, imagination, and more intrinsic motivation (Entwistle 1988). They have a tendency to be deep learners (Swanberg and Martinsen 2010). They positively correlate with universalism (equality, social justice, protecting the environment), self-direction (independence), hedonism (fun/enjoyment), benevolence (welfare of people close to them), and stimulation values. They are negatively correlated to conformity, security, and tradition and the most negative out of all the personalities to value of power (Parks-Leduc et al. 2015). They are negatively related to sensitivity of punishment (Mitchell et al. 2007). They are innovators that are seen as investigative and artistic (McCrae 2000). On the vocational interest, they are correlated with

investigative, social, and artistic interest (Mount et al.; Rounds 2005) and positively associated with all 6 self-efficacy types in interest (Hartman and Bentz 2007). They prefer open assessments that are not analytic, concise, or multiple choice (Chamorro-Premuzic et al. 2005). An open learner is linked to autonomy and the need to express their creativity. Motivation is does not need to be supported at the start of the learning process, but one needs to be careful to foster their level for intrinsic learning.

On the flipside, low openness is related to traits such as less abstract thinking, low intrinsic motivation, less willing to change, and high sensitivity to punishment because of sensitivity to cues of novelty and punishment.

3.1.3 Extraversion and Motivation

Extraverted learners need a more social and interactive environment. They are motivated to achieve rewards with goals. They have a high performance and are connected to relationship, adventure, achievement, being agreeable, escapism, and competence. They like challenges. However, they can reach cognitive decisions prematurely (Matthews 1997) and can talk more than studying, which can have a negative impact on academic performance (O'Connor and Paunonen 2007). They correlate with achievement, self-direction, power, stimulation, and hedonism. Extraverts tend to be happier and have a higher well-being in general (Anglim and Grant 2016; Steel et al. 2008). They have a tendency to cope with stress because of their level of stimulation and need for challenge (Carver and Conner-Smith 2010), which translates to possibly higher self-efficacy in general (Ebstrup et al. 2011; Şahin and Çetin 2017). Extraversion correlates with social interest versus vocational interest, and relates to artistic, social, and enterprising self-efficacy (Holland 1997). They are deep and strategic learners. They correlate with mastery approach and avoidance (Chen and Zhang 2011; McCabe et al. 2013). Their grade is dependent on the type of assessment. They prefer oral exams, short multiple choice, and group work (Chamorro-Premuzic et al. 2005). They might need more videos in their learning and opportunity to share their thoughts, as well as complexity added to their learning.

The opposite is an introvert. This learner prefers lower stimulation. Lower arousal tends to enable higher performance. They are reserved, cautious, sensitive to punishment, and have a high sensitivity to rewards (Corr 2004). They are prone to fear of failure and avoidance (Payne et al. 2007).

3.1.4 Neuroticism and Motivation

Neuroticism students tend to be lower in openness and conscientiousness (Chamorro-Premuzic et al. 2005). They have higher anxiety, anger, depression,

self-consciousness, impulsiveness, and vulnerability (Komarraju et al. 2011). Correlations for well-being are negative to neuroticism perhaps because they are predisposed to experience negative affect (Costa and McCrae, 1992; Anglim and Grant 2016). Neurotic learners are more failure-oriented and have a higher degree of external motivations and poorer achievement (Komarraju et al. 2011). They withdraw and tend to produce more amotivated individuals. They are more emotion focused and less focused on the task. There is evidence that they do better when kept busy and poor performance occurs when not. They are linked to lower self-esteem and liking short-term rewards. They are more surface-level learners because of their fear of failure (Busato et al. 1998). They do not have associations with value. They are correlated with sensitivity to punishment because they are vulnerable and had low self-esteem (Mitchell et al. 2007). They are more sensitive to ridicule, are uncomfortable around others, exhibit shy behavior and poor coping skills in stressful environments, and can be dependent on others (Costa and McCrae 1992). This learner would not fare well in competing or comparing to others. They have ties to procrastination (Watson 2001) and a tendency toward being negative (Matthews and Zeidner 2004). They prefer assessments that are not continuous. Four facets of neuroticism are related to performance approach goals, 5 facets of mastery avoidance, and all 6 facets were related to performance avoidance goals (McCabe et al. 2013). Research has shown ways to help avoidance individuals by reducing negative consequences, removing distractors such as dual tasks, not providing time pressures, providing structure and focus, and allowing them to clear their mind regularly (Roskes et al. 2014). On the flipside, the learner is emotionally stable. Low neuroticism is associated with preferring essays or oral exams (Chamorro-Premuzic and Furnham 2003).

3.1.5 Agreeableness and Motivation

Agreeableness is the trait that is found to least impact academic achievement. (Chamorro-Premuzic and Furnham 2003). Learners high in agreeableness are compliant, put others before themselves, and are trusting and good natured. Agreeableness is positively correlated with the values of benevolence, tradition, and conformity, and is negatively correlated with power and achievement because of putting others first, hedonism, stimulation, and self-direction. Individuals with high agreeableness avoid punishment due to their sensitivity to punishment and desire to not displease another or be perceived as disagreeable (Mitchell et al. 2007).

On the flipside, individuals low in agreeableness are manipulative and competitive. They are high on the sensitivity to rewards from increased aggressiveness and motivation to obtain rewards. They will pursue a reward even at the expense of

others. Consequently, learners with low agreeableness require more checks on learning during instruction and immediate feedback on the correct way of performing a task. They may benefit from tasks that engage them in the learning activity. Low agreeableness learners need more active learning versus passive learning. Agreeableness has the least influence on academic achievement of all of the Big 5 Personality traits. However, agreeableness is an important trait for successful team training outcomes.

3.1.6 Summary of Personality Traits

An individual contains portions of all 5 traits to varying degrees. When considering the best approach to motivate an individual, their level for all 5 traits needs to be considered. The traits will interplay. A learner that is high in openness, conscientiousness, and neuroticism has drive and persistence, but emotional instability. An individual with low openness and conscientiousness, and high neuroticism needs a different type of support. Thus, the present effort mapped the personality traits to different learning strategies to take into consideration all the traits a person may bring to the table when learning. They are broken into 4 quadrants (Fig. 10). The main traits considered are conscientiousness, openness, and neuroticism because of the connection to academic performance (Chamorro-Premuzic and Furnham 2003; Paunonen and Ashton 2001). There is also research pointing to linkage between academic performance and extraversion, and to a lesser degree, agreeableness. High extraversion is correlated with higher stimulation that is brought forth in social situations. Whereas, introverts are over stimulated in social situations (Eysenck and Eysenck 1985). Introverts are also prone to being avoidant. Perhaps this might be because of a lack of coping with overstimulation situations. However, in GIFT's current state, overstimulation from social situation is not a motivational factor for the introvert because of one-on-one instruction from the tutor. Figure 10 gives a broad overview of the 4 quadrants that will be looked at more in depth. Personality is placed within the quadrants and variables are folded within. This produced strategies and motivators related to the individual learner's needs (dependent on experiment of MAT) because the level of support and frequency matches motivators.

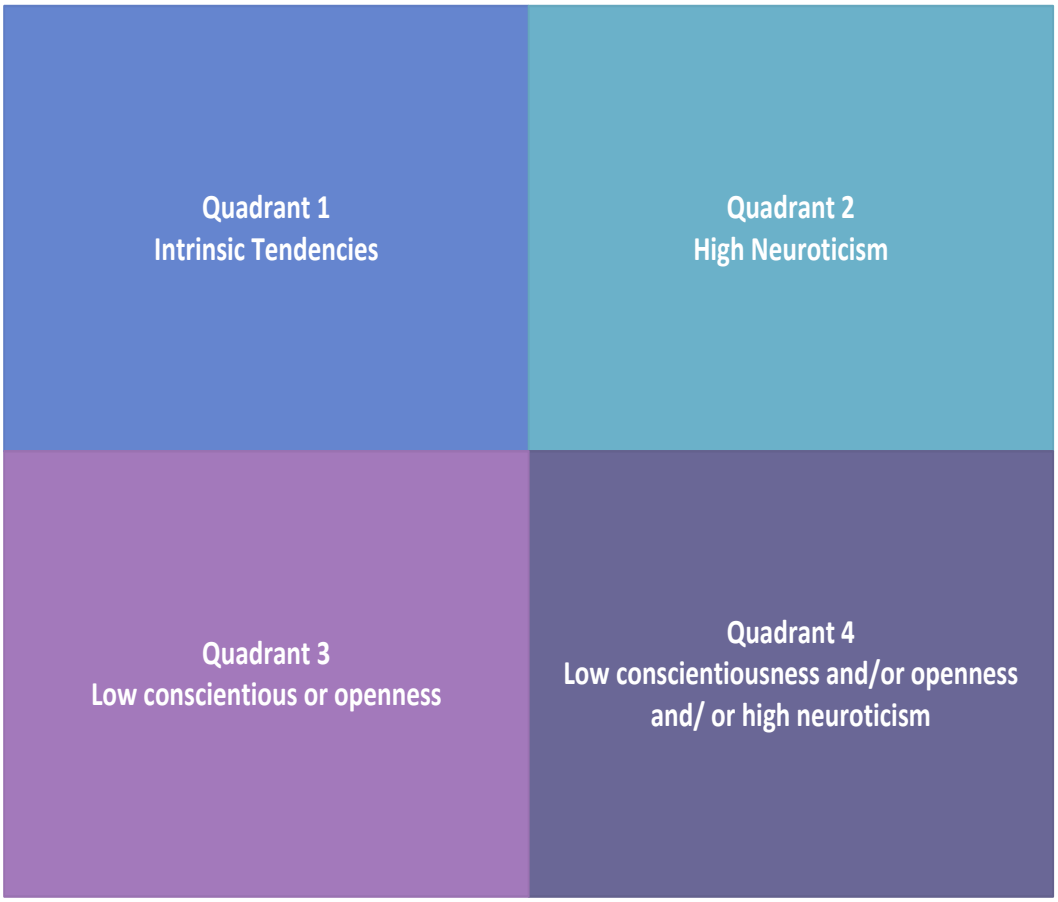

Fig. 10 Four quadrants macro overview

The design suggested herein will be modified according to data from the validation waves, but will serve as a plan for executing adaptation within GIFT. First, the MAT determines an individual's intrinsic and extrinsic motivation tendencies. Intrinsic motivation is something of inherent satisfaction (Calder and Staw 1975; Porac and Meindl 1982) and extrinsic motivation leads to doing something because of the outcome it leads (Deci and Cascio 1972). These quadrants can be mapped by personality or stringing of variables from the MAT. Quadrant 1 is an intrinsic motivated learner. Quadrants 2–4 are designated for various levels of extrinsic motivated learners. Ryan and Deci (2000) found that there is a continuum of determination and control ranging from incongruence with one's values and needs (integrated) to complete extrinsic rewards or punishments (external) and is discussed in detail in the extrinsic quadrants.

3.2 Quadrant 1: Intrinsic Learner Plan

The reason for an intrinsic learner plan is present in research on learning. This section is based on quadrant 1 and details the reason why GIFT needs to account

for this type of learner when adapting. Learners with intrinsic motivation are internally driven to succeed in the acquisition of knowledge, achievement, and stimulation. They are deep-level learners, high in persistence, and have a positive self-esteem (Deci and Ryan 1995), which assists in the retention of knowledge. Learners with intrinsic motivation are empowered through relevance (Baumeister and Leary 1995), autonomy over their learning (deCharms 1968), and competence (Harter 1978; White 1963). Literature presents that applying external forces can suppress intrinsic motivation (Deci et al. 1999). These external pressures reduce the internal locus of control, thereby reducing natural intrinsic motivation. Traditional teaching practices and many ITS design models place external limitations, rewards, and control that are undesirable and a hindrance to learners with intrinsic motivation that reduce performance. Including pedagogy consistent with the preferences of the learner with intrinsic motivation ensures that the learning environment nurtures their internal drive rather than detracting it.

The self-determination theory (SDT) looks at the broad picture of a learner and their natural, intrinsic drive for learning. While the Attention, Relevance, Confidence, and Satisfaction (ARCS) model of motivation (Keller 1987b) provides a categorization of instructional motivation and instructional strategies, application of the ARCS model does not alter individual behavior or teach self-motivation (Keller 1987b). The intrinsic motivated learner is already high in the 4 ARCS variables without requiring external incentives or controls, but the strategies provide considerations on instructional motivation for an intrinsic motivated learner in GIFT. Attentional strategies provide variance on individual learners, such as varying tone of voice, medium (video, sound), and style (humor, pace, and noise level). Relevance during instruction is developed through challenging goals and relation to the future. This matches an intrinsic motivated learner's quest of knowledge. Confidence is related to affect, self-esteem, and self-efficacy, where intrinsic motivated learners are prone be attributed to positive outlook from a deep level of learning values. Confidence is enhanced from a self-plan of work, low risk for new skills, and independence. Intrinsic motivated learners need to have the strings cut from traditional learning to allow a more natural satisfaction of understanding. Of course, it never hurts to surprise someone by throwing a noncontingent reward that enhances, but does not undermines values.

In addition to providing support for the ARCS model variables, the ITS in GIFT needs to also provide a means of supporting the intrinsic motivated learner's self-regulation strategies. Self-regulated learning (SRL) and a learning strategy that supports the learner with intrinsic motivation are similar in terms of the level of choice, voice, and relevance provided throughout the learning process (Azevedo 2005). SRL is the initiation of one's thoughts, feelings, and behaviors toward

reaching a goal (Zimmerman 2001; Zimmerman and Schunk 2011). Learners with intrinsic motivation have a higher proper use of metacognitive and cognitive strategies like elaboration, rehearsal, and organization (Wolters 1998). However, choices for length, amount, and type of organization options can be provided during the task and practice. Other self-regulated strategies to be considered are managing time effectively, actively seeking help, believing in one's self, and conducting self-evaluations (Schunk and Ertmer 2000). Intrinsic motivated learners fit the profile for mastery goal learners. They strive to increase competence of themselves and reach higher levels of learning, knowledge, and performance (Bell and Kozlowiski 2002), and higher motivation (Colquitt and Simmering 1998). The Universal Design for Learning is a framework for designing lessons based off the notion everyone has different learner variables. The needs of the variables are accomplished through different "pathways" ranging from tools, strategies, and scaffolds for reaching mastery or expertise (Meyer et al. 2014). It provides guidelines on when to implement different ways of personalizing. The intrinsic motivated learner should have options for different ways to display the information, such as auditory or visual information. GIFT is able to provide clarification of vocabulary and symbols, illustrate through multiple media types, activate or provide background knowledge, highlight patterns, and describe big ideas and their relationships. The intrinsic motivated learner also needs to be provided different ways of action and expression.

Many researchers have tested different pieces of self-regulation and extrinsic effects with intrinsic motivated learners with ITS or computer-based tutoring (CBT). However, unless we account for all the variables and plan for maximum choice, the true outcome of learning tailored to support an intrinsic motivated learner will remain unknown. In this scenario, elements of strategies from the ARCS model, self-regulation, goal orientations, and the requirements of the intrinsic motivated learner are used to maximize autonomy, relevance, and competence. This all points to the direction that motivation with respect to learning is connected to multiple variables and instructional strategies. The goal for the present work is to align the variables (learner individual differences) and specific strategies an individual is learning to achieve optimum levels of motivation for an ITS.

It is possible that certain personalities will map to be intrinsic learners. When doing a mapping of personality and thinking about each personality. The variables of an intrinsic learner interact with the personality traits of high conscientiousness, low neuroticism, and high openness. It is possible, that high extraversion is related to a higher well-being, happiness, and general self-efficacy might also play a role in

being an intrinsic learner. A prediction is the following personalities might attribute to higher intrinsic tendencies:

1) high openness + high conscientious + high extraversion + high agreeable + low neuroticism
2) high openness + high conscientiousness + high extraversion + low agreeableness + low neuroticism
3) high openness + high conscientiousness + low extraversion + low agreeable + low neuroticism
4) high openness + high conscientiousness + low extraversion + high agreeableness + low neuroticism

If the MAT does correlate with personality, then possibly the personality test alone could automatically place a learner on an intrinsic learner path. The rest of the personality mapping ideas are in the extrinsic learner plan.

3.2.1 Idea Development for Quadrant 1: Intrinsic Learner

Table 3 shows an overview of the intrinsic learner plan for Quadrant 1 personalities. These are levels of adaptations that an ITS could supply to this type of learner based off the MAT or personality.

Table 3 Intrinsic learner support overview

Support	Low	
Support Type	Maximize autonomy	
Goal	Write own or select the mastery goal	High complexity
Feedback	Correct/ incorrect feedback	1) Incorrect answer is shown the correct way. This will stop faulty mental models. Learner can choose to write about their mistake.
Task	Pick the type of task:	1) Traditional active task 2) Playground-problem/scenario based 3) Allow them to find and create (if applicable)
Reinforcer	Surprise noncontingent reinforcer at end	

The process flow is generic to any ITS. It serves as an example for a level of adaptation made for the intrinsic learner.

The process flow in Fig. 11 describes a typical flow a lesson plan with adaptations made for an intrinsic learner. This flow begins giving choices to the intrinsic/high autonomy learner. Motivation occurs from autonomy, competence, and relevance for an intrinsic learner. Basic adaptive authoring will be used for Year 2 because instructors that author courses are not computer engineers. They will first need to author a basic course flow before learning the aspects of implementing MAT into a more stimulated environment. A simulated environment through gaming situations with MAT is perhaps a focus of Phase 3. The adaptation effects to learning will first be mastered within an instructor's capability with technology.

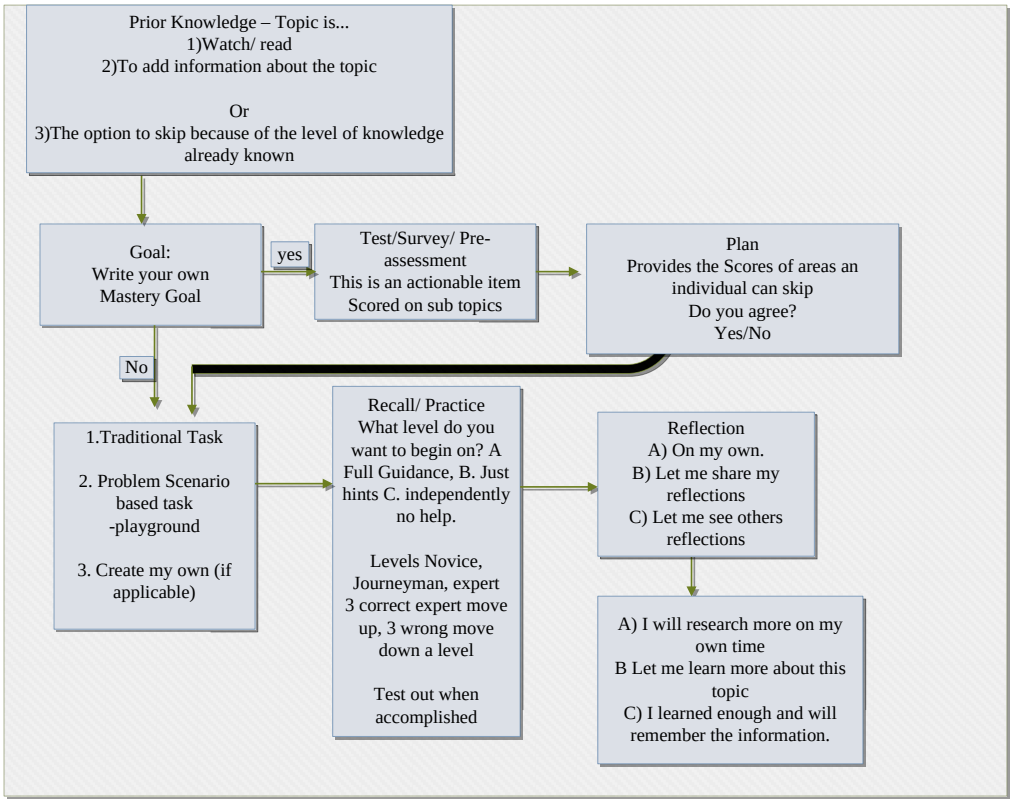

Fig. 11 Intrinsic learner process

3.2.2 Prior Knowledge, Goal Setting, Preassessment, and Plan

In planning of self-regulation, learners activate prior knowledge, set goals, and monitor progress (Schraw et al. 2006). The intrinsic learner plan will provide the learner with an option to demonstrate their prior knowledge before they begin the course by providing 3 options: 1) requesting a preview/summary of information needed prior to the task, 2) sharing their prior knowledge, or 3) opting out because of their high level of knowledge on the topic. Learners who lack prior knowledge and have intrinsic motivation will likely select the first option to review the lesson content before starting the lesson. Learners also have the option to select the format

of the lesson content preview—such as either reading text, watching a video, or listening to an audio script. The second option, to share their prior knowledge, can be implemented by having the students record a video/audio file or writing/typing a summary of their knowledge. The last option monitors the learner's understanding of the topic. If they have a high understanding of the topic, they will skip the prior knowledge because of the quick activation. This completes the first choice pathway. The next section gives choices regarding the goal and value of the topic.

Learning goal preference is a variable of motivation used in the MAT to ensure the intrinsic motivated learner's goals align with their preferences. Goals increase the commitment level of the learner resulting in them extending more attention and effort (Kernan and Lord 1990). The goal needs to be provided at the correct level of challenge. Intrinsic motivated learners typically have a goal of complete understanding and absorption of knowledge, and may want to write their own goal. If they are unsure on how to write a goal, they also have the option to pick a goal that will meet their level of entry and continue to challenge the learner.

Mastery goal orientation is has connections with the tendencies of an intrinsic learner. The mastery goal learner is after seeking knowledge and competence. It is tied to positive affect for learning and picking something more complex as a task (Farr et al. 1993). This type of learner is also related to self-efficacy (Bell and Kozlowski 2002) and grit (Colquitt and Simmering 1998) and frequently uses metacognitive strategies (Ford et al. 1998). Thus, the learner has an increased level of motivation throughout the task (Colquitt and Simmering 1998). This goal is chosen for the intrinsic learner because of the interconnections of the mastery goal orientations and to the fit of this type of learner. The personalities, mapped to this quadrant also would be linked to mastery approach. Providing a learner autonomy the learner can bypass the goal and write their own goal to attain. This also provides relevance to the learner.

Motivation is affected by forcing individuals to relearn sections of information already established. If the learner is knowledgeable on the topic, then the preassessment not only allows them to skip sections but also gauges time management. ITS will prompt the learner to reflect if the preassessment will be valuable to them. Administration of the preassessment should only transpire if they are knowledgeable on the subject. Presenting a plan according to the data accumulated spells out areas of weakness and strength. The learner then has the option to skip areas of strength. The freedom to pick sections they feel confident without a preassessment is not provided because of the research showing inaccurate self-assessment of a learner's knowledge (Brown 2001). Thus, a low-risk preassessment is used to provide accurate information when deciding on an action plan. This furthers the pathway for allowing intrinsic motivated learners to have a

voice and choice on their plan for learning. In contrast, low knowledge of the subject wastes precious learning time by taking the preassessment.

3.2.3 Task and Practice

Usually a lesson is designed so that all students learn within the same type of design—either a common scenario or problem to solve. Due to the relevance of deep learning and need for student autonomy, it is recommended that the learner be provided options on how the instruction is provided to the student. Traditional delivery, problem based/scenario based, and "create my own if applicable" were chosen because of the level of student-centered learning those tasks provide. By providing some variance in the traditional task, the possibility to explore differences between different types of task motivation, retention, and personality selection is enabled. A traditional lesson of PowerPoint will be used to gauge the effect of personalization through a traditional task of providing information and then practicing. It will still be personalized on complexity, preference, chunking, and so on.

The intrinsic motivated learner should be able to select the level of guidance they need to begin practice based off their competence of the subject. Consequently, recommending that the intrinsic motivated learner be presented with 3 options for instructional guidance. The first level is to provide no guidance to the learner to help them with the task. The next level of guidance provides hints to the learner. In this case, if the learner is competent they can walk through most of the steps for answering the questions, but may need assistance at different points. The last level is the maximum level of guidance. The ITS walks the learner through the entire process and reasoning with the learner to answer the question. These levels follow the zones of proximal development (Vygotsky 1978) of the "I do, we do, you do". If the learner provides 3 wrong answers in a row, the ITS can automatically kick them to the previous level of guidance. However, 3 correct answers in a row would move them to the less guidance on their own. Three correct answers on own without help will move the learner out of the assessment. The 3 questions asked are of easy, medium, and hard complexity level based off of Bloom's taxonomy (Bloom 1984). This speeds up the practice and there is no set amount of problems set to pass the practice section. The computer will offer more time to practice if the learner feels they need it and this way they will be self-monitoring their progress (Zimmerman 2001).

Practice is a low-risk formative assessment because there is not a score provided for this time. Low-risk assessment is needed to maintain motivation, especially if the intrinsically motivated learner is low on entry on the topic and confidence. Intrinsic motivated learners will only be shown pass/fail grade in GIFT. Passing

practice would provide a passing grade to the learner. This increases the level of success and decrease the level of control an assessment brings. Data collection is seen through the practice session. Learners are able to practice until they feel competent and have a deep-level learning and beat the different levels of complexity independently.

3.2.4 Reflection, Competence, and Surprise

Some learners naturally reflect on their own. Some are curious to see how others reflected and if they missed any key points in their learning. Others do not like to reflect, but would rather hear a proper reflection. Reflection is an important part of processing the information. This is a prompted self-regulation skill. Learners could reflect on themselves or their learning. The intrinsic learner has already achieved in passing and reflected deeply on their learning. This competence section is aimed at the intrinsic level of satisfaction from the amount of information that was provided. They may want to continue learning or deepen their understanding, which equates better retention. They can choose from researching more on their own time, learn more about the topic, or learned enough about the topic. The intelligent tutor will need to know if the learner has enough satisfaction in the amount of information that was provided. A noncontingent reward during the task or practice will be used to increase motivation. This might be a motivational quote, funny animation, or a piece of candy. While external motivators are needed by the learner with extrinsic motivation, the fact that it is noncontingent means it will not undermine intrinsic motivation but will increase motivation**.**

The intrinsic scenario is built to open traditional methods into more student-centered practices by giving choice, voice, and relevance to their learning. It also provides adjustments to meet their level of need for learning. Intrinsic learning intertwined with autonomy, self-regulation, motivational design, and the universal design of learning is used to see the potential increase in motivation and the effect it has on learning rate and retention. See future sections for further considerations on increasing student voice, relevance, and instructional strategies to GIFT.

The main ideas implemented in the intrinsic learner plan can be carried over to use with the extrinsic learner plan. For example, a video or the main task can be used in the extrinsic learner plan, but have more motivators involved in the adaptations of the course. This way, authoring the 2 separate adaptations will not require much more time for the instructor. The Phase 2 experiment will pick the most important pieces of the intrinsic learner plan to be carried out.

3.3 Quadrants 2–4: Extrinsic Learner Plan

This scenario is dependent on the level of support their personality mapping falls under or the more detailed specifics answered from the MAT. Learners will have various levels of specific feedback, time schedule of when reinforcers are used, and different levels of support based on their personality. It is not so clear-cut for extrinsic learners. Some researchers disagree with applying external rewards (Deci et al. 2001), others agree that external rewards bring benefit the learner (Gagné and Deci 2005) and are not always harmful (Eisenberger et al. 1999).

Society commonly imposes nonintrinsic tasks on a learner. However, Ryan and Deci (2000) posit that humans are born as intrinsic learners. Habits are formed and some learners now expect extrinsic reinforcers in exchange for outcomes in addition to the topic simply being of interest. Therefore, both expectations developed from experience and interest in the topic is understood. External motivation shifts the focus to outside significance for learning in combination with an internal gratification, such as success. Acknowledgement, authority, peer pressure, grades, and the promise of a reward becomes the focal point of external factors. A task that is extrinsically motivating produces a different entry level of motivation. This motivation is harder to maintain because success relies upon external factors for completion that matches the individual's level of expectation and preference. An extrinsic learner is attempting to gain or avoid. Extrinsic motivation that still provides the learner a level of control is able to provide a learner with higher levels of performance (Miserandino 1996) and well-being (Sheldon and Kasser 1999). Extrinsic learners are either strategic learners or surface learners (Cassidy and Eachus 2000). A strategic learner's intention is for the highest grade possible and a surface learner is to learn the minimum requirements.

Extrinsic motivation can be broken down into a continuum known as Organismic Integration Theory (OIT; Ryan and Deci 2000, Fig. 12). Starting with internal control known as integration (regulation has been integrated within their sense of self), identification (person sees the importance of the activity), introjection (controlled by inside factors such as self-esteem), and external regulation (controlled by demands or contingencies; Ryan and Deci 2000). Integrated falls very high on self-regulation (Deci et al. 1996). Identified falls as being part of an intermediary level of self-regulation because of the importance of the activity. Introjected has a moderately low level of self-regulation because of being controlled inside (e.g., self-esteem) and external is very low and needs to be controlled by demands. The MAT might see similar patterns from individuals or provided that self-regulation is a finer tailoring to the individual and individuals may have a compilation of those due to the personality mapping.

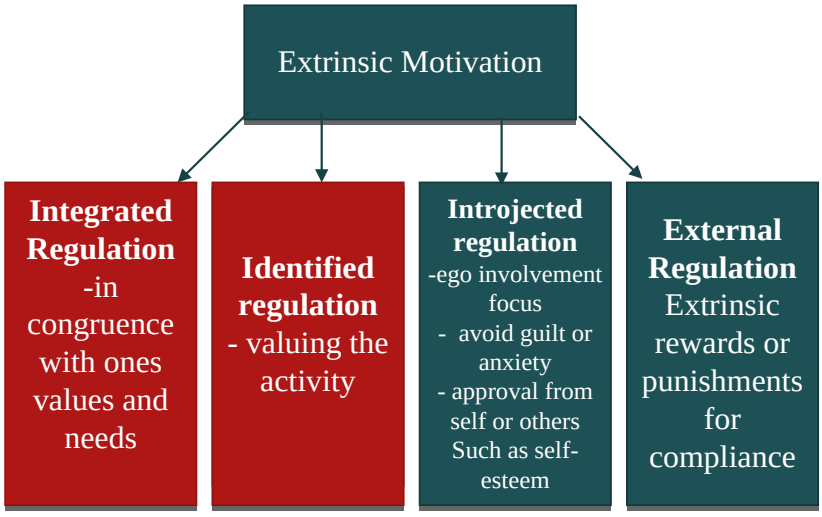

Fig. 12 Continuum of an extrinsic learner

The adaptive course flow is complicated for the external learner in comparison to an intrinsic learner. The level of complexity is increased due to the need to continuously maintain motivation to enable a higher level of academic performance and retention. The requirements of an extrinsic learner layered with other motivation interconnections and personality is dynamic with multitudes of motivators to select. For Phase 2, a select set of motivators will be validated, possibilities are tokens, timers, acknowledgement, leaderboards, or a tangible item. The frequency, control, and support level are drawn out within the different quadrants (pending on MAT results). If there is no connection to personality, then the plan will be dependent upon individual rules as seen in the individual rule section from the MAT.

A task, extrinsic to the learner, develops variance of value to learning the task. This level of value does not always match a motivational level for maximizing deep learning engagement. Value for some extrinsic learners resides in the outcome provided from achieving the outcome and not the actual learning that occurs. Thus, options for some quadrants are removed. Since learners might not have the motivation to be deep learners, they need to have more review and more accountability for the information. If they do not meet their goal by the end of the assessment, the course is not over and the computer will automatically flip the learner into a different task. Maybe the task was not the correct fit for the learner to process the information. The learner does not need to be aware of having to do the same process, but it could feel like the learning task continued after the questions. This may increase the learning rate, but it is important that the extrinsic learner reach success at the end of the course.

3.3.1 Idea Development for Quadrant 2: High Neuroticism

The second quadrant are learners high in neuroticism, but also high in conscientious and openness (Fig. 13). On the MAT, these individuals are expected to produce results consistent with struggling with their emotional well-being and anxiety, but with a high level of effort and interest. Emotional instability is a contributor to low academic achievement and avoidance. A need for emotional support and competence become evident when mapping this type of person's other traits. This falls in line with introjected self-regulation where one deals with issues such as self-esteem. The level of self-regulation is moderately low due to the emotions being kept inside (Deci et al. 1996). It also falls in line with integrated and identified regulation because of their openness and conscientiousness. They already come valuing the task and achievement. The learner may have a difficult time with their emotions and giving up (avoidance), but is balanced by a drive for perfection and achievement, and open to experiences and learning new ideas. This type of person battles to overcome their emotions and constant need to feel successful. They have the tendency to be mastery avoidant or performance avoidant, but link to a mastery approach in conscientiousness (Elliot and Thrash 2002). Steering away from avoidance behavior is key. Added support is suggested to tend to their specific requirements for competence, emotional support, and success. Extraversion and agreeableness is shown in groups to depict an even more granular refinement of motivating the individual. Both types of high and low extraversion are capable of high academic achievement. They are split into groups by those factors that determine competitive and learning preference (individual vs. team) as seen and explained further in Fig. 13.

- **High agreeable and low extraversion**

high openness + high conscientiousness + low extraversion+ high agreeable + high neuroticism

high openness + high conscientiousness + low extraversion + high agreeable + high neuroticism

- **High agreeable high extraversion**

high openness + high conscientiousness + high extraversion+ high agreeable + high neuroticism

high openness + high conscientiousness + high extraversion + high agreeableness + high neuroticism

- **Low agreeableness and low extraversion**

high openness + high conscientiousness + low extraversion+ low agreeable + high neuroticism

High openness + high conscientiousness + low extraversion + low agreeableness + high neuroticism

- **Low agreeableness and high extraversion**

high openness + high conscientiousness + high extraversion+ low agreeable + high neuroticism

high openness + high conscientiousness + high extraversion + low agreeableness + high neuroticism

Fig. 13 Hypothesized personality mapping for Quadrant 2

This learner needs to remain competent and express their feelings intertwined with the task. They generally have lower self-esteem, self-efficacy, perhaps strategic/surface-level learning because of the emotions. However, they are battling against persistence, grit, and creativity. Driven but vulnerable, their plan needs to be cautious and emotionally positive based. The task needs to build from a low level to a more complex level through subgoals and always remain on a level of success. Mistakes are worrisome and need to have the mindset of feedback for growth and not a punitive measure. This learner might retain better with expressing their feelings and intertwining it into the lesson. It will be important to set up the reflection in this direction.

Table 4 Quadrant 2 support overview

Support Level	Medium	Introjected regulation because of self-esteem and avoidance. However, they are also integrated and identified regulation because of value and needs seen by the learner.
Support Type	Emotional and competence	Low complexity
Goal	Subgoals	
Feedback	Correct/incorrect feedback Empathetic Growth mindset	1) Incorrect answer will be shown the correct way. This will stop faulty mental models. 2) Learner can choose to write about their mistake. 3) Empathetic and/or growth mindset can be added to the comment or as a separate entity.
Task	Pick the task:	1) Traditional active task 2) Playground- problem/scenario based 3) Game
Motivator	Surprise noncontingent reinforcer relaxation stress reducing Build competence at beginning, (e.g., You will be successful if you put the effort forth!) Breaks to encourage relaxation More reviews and reflection with an emotional attachment Motivators – less and bigger	

The process flow in Fig. 14 needs to include relaxation techniques and building competence (positive mindset and self-talk), and remain at the lower level of this learner's knowledge to build success (Table 5). The learner should not take the preassessment after 3 answers wrong because getting more mistakes might make them avoidant or frustrated. They can pick the type of task that is broken into subskills. Feedback that is empathetic and of a growth mindset is planned alongside correct and incorrect answers. Incorrect answers must not be called a mistake, but learning. The practice should always begin with language such as I do (learner watch), we do (learner has hints available to help), you do as a novice level, and brought up. They do not need to know that they are starting at a novice level. Since they are high in conscientiousness and openness, the review needs to tie in emotions for remembering or competence. This can be set into the guiding questions for review on having them reflect. Then provide a relaxation technique, breathing, or mindfulness to help reduce their anxiety and build up their competence on the task with a quote or short video. To see their depth of knowledge versus a traditional task, learners will write short responses or extended responses that are graded on a rubric. Learners in this quadrant will be guided to review main points learned within a relaxation exercise reflect on experience and successes of what they comprehended. If a learner doesn't understand the information they can be sent to another task. This can be done on each subskill as the formative assessments or recall determine readiness to reach another subskill toward the goal.

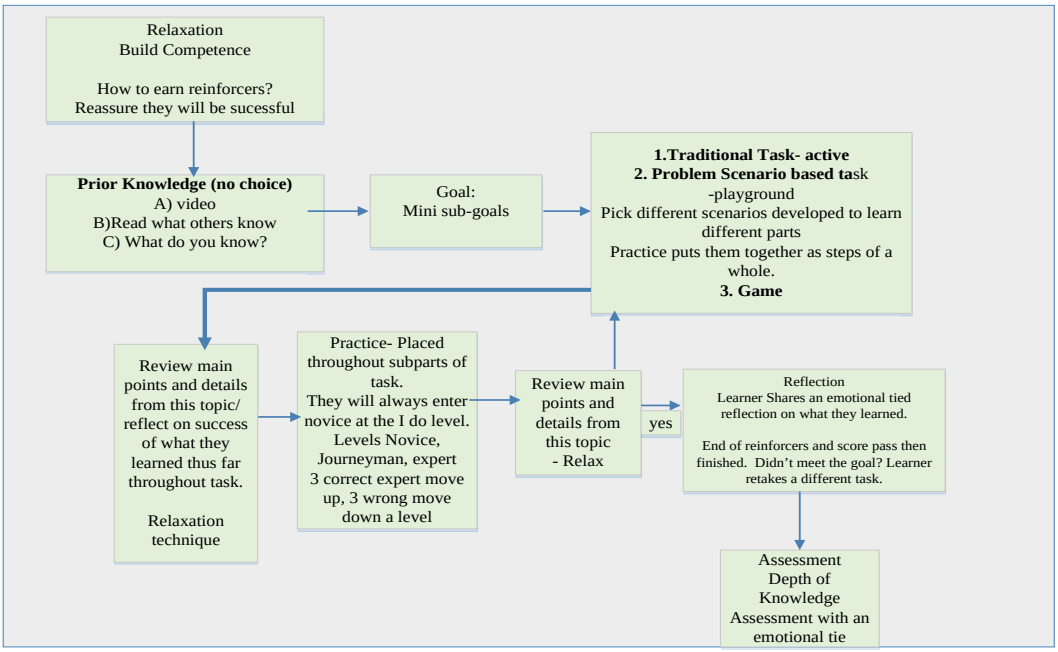

Fig. 14 Quadrant 2 process

3.3.2 Idea Development for Quadrant 3: Low Conscientiousness or Openness

The third quadrant is broken into learners that are low in conscientiousness or openness. These learners need more support in focusing, organization, patience, grit, and steering away from procrastination. Low openness yield traits such as less abstract thinking, low on intrinsic motivation, less willing to change, and high on sensitivity to punishment because of sensitivity to cues of novelty. Focusing on strategies that tailor to less abstract thinking, low motivation, and maintaining tradition. These personalities were grouped with learners that are in combination with low neuroticism.

The mapping is as follows:

Quadrant 3: One area of low in either conscientiousness or openness personalities:

High agreeable and low extraversion

1) Low openness + high conscientiousness + low extraversion + high agreeable + low neuroticism
2) High openness + low conscientiousness + low extraversion + high agreeable + low neuroticism

High agreeable high extraversion

3) Low openness + high conscientiousness + high extraversion+ high agreeable + low neuroticism
4) High openness + low conscientiousness + high extraversion + high agreeableness + low neuroticism

Low agreeableness and low extraversion

5) Low openness + high conscientiousness + low extraversion+ low agreeable + low neuroticism
6) High openness + low conscientiousness + low extraversion + low agreeableness + low neuroticism

Low agreeableness and high extraversion

7) Low openness + high conscientiousness + high extraversion+ low agreeable + low neuroticism
8) High openness + low conscientiousness + high extraversion + low agreeableness + low neuroticism

Table 5 shows the overview for Quadrant 3. While this learner is emotionally stable, they are low in conscientiousness or openness. They are not in a battle over their emotions but with relevance, this task holds to them. They need support in the area of creativity, organization, abstract concepts, focus, and reviewing more than once because of lack of interest or detail. This person needs a higher level of support than above because of their lack of interest, procrastination, organization, effort to avoid abstract ideas, and thinking outside the box.

Table 5 Quadrant 3 support overview

Support Level	Medium to medium/ high	
Support Type	Organize, detail, push to abstract, repetitive review	
Goal	Subgoal, value of task	Begins low complexity
Feedback	Correct/ incorrect feedback Focus, self-regulation for organization	1) Incorrect answer will be shown the correct way. This will stop faulty mental models. Learner can choose to write about their mistake.
Task	Pick the type of task:	1) Traditional active task 2) Playground-problem/scenario based 3) Game Low focus parts of different task that yield higher stimulation More review sections Forced push to abstract Forced reflection
Reinforcer	Motivation begins at start of task (e.g., noncontingent) More frequent smaller amount Punitive: loss of points (extremely too long, way too many wrong)	

Figure 15 provides their overall process flow for a Quadrant 3 learner that is low conscientiousness or openness. Motivation needs to be boosted from the beginning. This learner's noncontingent reward is given at the beginning of the task. Value of the task must be provided because this learner does not see the relevance of this task. Clear rules and expectations for the reinforcer being used is also given. This learner will watch a prior knowledge video and will have to write what they learned.

They are not emotional learners so they will take the preassessment to test their knowledge and pass out of sections. Their goal will be in subgoals and meeting progress. The topics will be broken into subgroups each subgroup will contain the practice or formative assessment. The learner can pick the task. This includes a game since games have extrinsic features. If the learner does not pass the first subtask they can take the subtask of a different task and repeat until they meet the achievement of the subgoal for that section. A review will be given to remind the learner of the important points and details learned in that subtopic. A small break to refocus their attention will be given through physical movement or animation video about working hard. Organizers, classifiers, and focus reflection will be given to help deepen the understanding of the learner. The learner will proceed through the subtask until completion. Completion occurs after they meet their subgoal and assessment. A final review and reflection of all the things learned is planned.

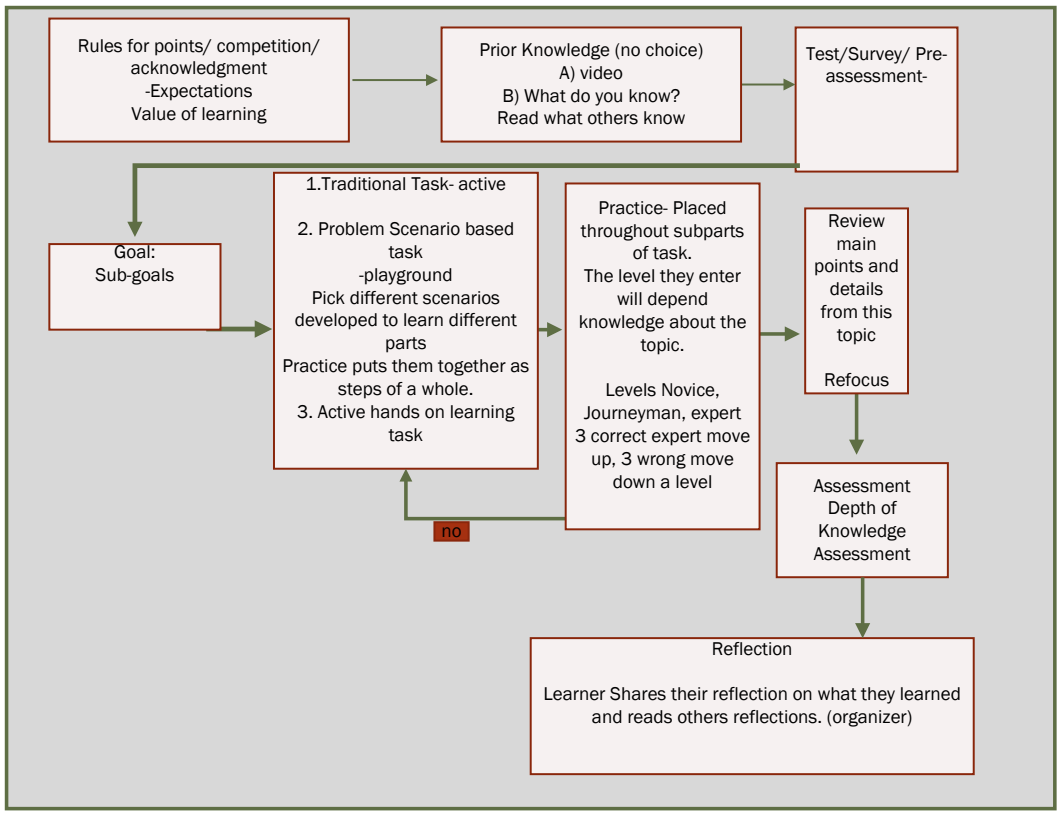

Fig. 15 Quadrant 3 process

3.3.3 Idea Development for Quadrant 4: Low Conscientiousness and/or Openness and/or High Neuroticism

Quadrant 4 is the learners who need the most support because they have multiple lows in either conscientiousness and/or openness and/or high neuroticism. This quadrant is predicted to be the learners that need external control and continuous

support. They are expected to represent the external regulation or amotivation sections of the SDT (Ryan and Deci 2000). They need both emotional support and organizational, focus support. While there are more of these personality maps, it is predicted that this also makes up the smallest percent of the population. They might have become removed from an intrinsic learner because of past experiences that initiated low self-efficacy, low self-esteem, and carelessness. It has been noted that some of these personality trait strings make up disabilities such as ADHD. Learners struggling to focus or holding still are attributed to the personality traits being high in neuroticism, high in extraversion, low in agreeableness, and low in conscientiousness (Mitchell and Nelson-Gray 2006). These learners need motivation from the beginning. They need a task that gives them success at a less complex level to start building their self-esteem and self-efficacy. They need to learn the material in multiple ways that incorporate repetition. They need to have more guided direct instruction before receiving practice. Knowledge that this person has low tolerance and can shut down over just a simple mistake. They need to stress accomplishments and visuals. This learner might fall into the "at risk" tier. The 4 underlined are the most extreme out of the set of personality mappings:

High extraversion low agreeableness

1) high openness + low conscientiousness + high extraversion + low agreeableness + high neuroticism
2) <u>low openness + low conscientiousness + high extraversion + low agreeableness + high neuroticism</u>
3) low openness + high conscientiousness + high extraversion + low agreeableness + high neuroticism
4) low openness + low conscientiousness + high extraversion + low agreeableness + low neuroticism

High extraversion high agreeableness

5) <u>low openness + low conscientiousness + high extraversion + high agreeableness + high neuroticism</u>
6) low openness + low conscientiousness + high extraversion + high agreeableness + low neuroticism
7) low openness + high conscientiousness + high extraversion + high agreeableness + high neuroticism
8) high openness + low conscientiousness + high extraversion + high agreeableness + high neuroticism

Low extraversion and low agreeableness

9) low openness + high conscientiousness + low extraversion + low agreeableness + high neuroticism
10) low openness + low conscientiousness + low extraversion + low agreeableness + high neuroticism
11) high openness + low conscientiousness + low extraversion + low agreeableness + high neuroticism
12) low openness + high conscientiousness + low extraversion + low agreeableness + high neuroticism

Low extraversion and high agreeableness

13) low openness + low conscientiousness + low extraversion + high agreeableness + high neuroticism
14) low openness + high conscientiousness + low extraversion + high agreeableness + high neuroticism
15) high openness + low conscientiousness + low extraversion + high agreeableness + high neuroticism
16) low openness + low conscientiousness + low extraversion + high agreeableness + low neuroticism

Quadrant 4 is the most intense, but predicted to have the least number of learners. This is an at-risk learner. They are at risk because they have more than one area that is linked to low academic achievement. They come in with the lowest form of regulation and motivation and are probably at an external motivation category and maybe amotivated. They are low in openness and/or conscientiousness and/or high neuroticism. They have a difficult time with their emotions, focus, organization, competence, and vulnerability, and do not hold value for achievement. They need maximum support of external factors to help navigate through learning. Length of learning, time spent on a single task, stimulation, color coding, depth of the material, feedback, and motivator all need to be considered when presenting materials. Table 6 shows the factors from the MAT anticipated to be associated with this type of personality mapping.

Table 6 Quadrant 4 support overview

Support Level	High	
Support Type	Emotional, focus, organization and competence	Low complexity
Goal	Subgoals	
Feedback	Correct/ incorrect feedback Empathetic Growth mindset Focus, self-regulation, progress	1) Incorrect answer will be shown the correct way. This will stop faulty mental models. Learner can choose to write about their mistake. Also, empathetic and/or growth mindset can be added to the comment or as a separate entity.
Task	Mix up the task based on high stimulation of task:	1) Traditional active task use sub 1 first 10 min. 2) Playground: problem/scenario based use sub 1.1 15 min. 3) Game use sub 1.2 15 min. 4) formative pass subtask 2 fail different sub section 1
Reinforcer	Surprise noncontingent reinforcer relaxation stress reducing Build competence at beginning (e.g. You will be successful if you put the effort forth! Value your effort is important because…). More frequent breaks: video, relaxation, physical movement More reviews and reflection with an emotional attachment No preassessment: we have a limited attention span and emotion (this may waste important motivational effort) Begin at low complexity More comprehension checks Organization by color	

The flow for this learner (Fig.16) needs to remain at a high expectation level while at the same time providing the right amount of information. Too much information or too deep will automatically lead to trying lack of effort. The feedback needs to remain consistent, balancing positive to negative motivators. Learning needs to

occur with time in mind given this learner's low and limited motivation. Therefore, the preassessment was removed because this learner needs low complexity and to remain in the priority task at all times. Prior knowledge on the task is limited to 5 min. The goal is a mini goal that is shown throughout the task. This learner is going to need the highest stimulation of each of the tasks. This is to keep their attention and motivation. Breaks to relax and reset their focus will likely occur more frequently. They need the material to be reviewed often to ensure learning for comprehension of the material.

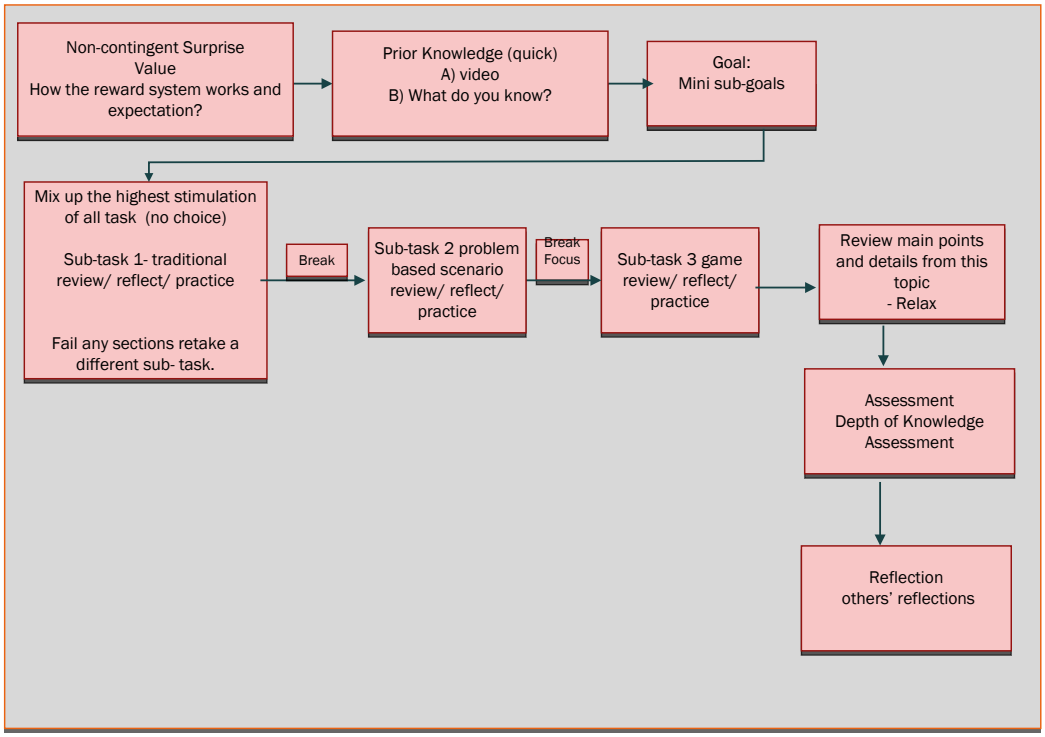

Fig. 16 Quadrant 4 process

The ideas mentioned previously are dependent on the results from the MAT validation waves. If strong relations occur between personality and motivation, then these personality mappings can be used to individualize. However, if strong relations are not found, the MAT assessment will become a rule-based assessment for providing specific information to the learner.

4. Recommendations for GIFT Advancements

GIFT is an adaptive training tool available free for researchers and, in the future, instructors. Creating basic courses is easy to do without having a computer programming background. The adaptive courses are more difficult to author due to some areas requiring software code or scripts to be modified or written. Also, an

updated manual written for new users on all the basic functions and more complex functions within GIFT is needed as the recent GIFT updates are not yet captured in these documents. This would help researchers and instructors learn to execute complex authoring for adaptive courses. It is also recommended that this manual contain all the information in a single document with hyperlinks rather than the current form in which it is spread out over multiple papers or in disparate sections on a Wiki. An exemplar course developed in GIFT employing the different stages of knowledge/ability with GIFT will also help the new GIFT user. This would save ARL time and money in addressing individual users' needs to learn GIFT. Providing all ARL GIFT project teams with a detailed user manual and upfront course, such as the GIFT Summer Camp, would be beneficial to learning the details for authoring adaptive courses.

This effort has created some forum topics, such as saving a long survey into GIFT (cloud version). The first attempt to save the MAT resulted in an error that prevented the MAT course to be saved, so a forum topic was created. While the GIFT support team developed a solution to fix the error, our team employed a workaround in which the survey was broken into several smaller surveys so that GIFT could support it. The same error was replicated in the downloadable version of GIFT. The GIFT support team has since provided an update to GIFT (cloud and download versions) that has corrected this issue.

Another help ticket was created by this project regarding the output of the data from the surveys. When running pilot studies for the MAT waves, it was discovered that the computer-generated tags associated with each survey item response were not based on the order of the questions entered or the number of the individual items. Consequently, it was difficult to read the data in Excel or other statistical programs for analysis. The ARL GIFT support team has addressed this issue. However, as a workaround, our team developed a batch-processing script to rename the item response columns by the survey tags and order the columns by the presentation in the survey. The ARL fix has also recently been deployed to GIFT cloud.

GIFT Cloud strives for quick authoring of training, but our team encountered long wait times when saving or adding new items. For example, opening up a survey took a minute to a couple of minutes. The delay between each typing and it showing on GIFT assessments took at least 30 s. As a workaround to improve efficiency, the questions from the survey were typed in Qualtrics and then transferred into GIFT.

A few authoring changes are recommended. The first recommendation is to provide an option to apply the same format, such as a radio button answer selection, to the entire survey, rather than having to select the answer selection for each survey item. Another recommendation is to allow users to save their assessments and transfer

them to a Word document for easier editing and use in reports. In other words, it does not currently appear that assessments entered into GIFT can be retrieved in any other complete format. GIFT allows users to save their assessment within GIFT, but it does not allow for export outside of GIFT.

GIFT's instructional feedback options run on a continuum of positive to negative. However, it does not appear that that there is a bank of different types of feedback available for tailoring instruction to the user, which would save time in authoring new courses and inform authors of additional options that they might otherwise not know. Different types of feedback might include instructional feedback, which provides the learner with information pertaining to their learning, and motivation feedback, which helps to encourage the student in the learning process. Instructional feedback is specific to the immediate learning task and the learner's performance. For example, instructional feedback can provide information to the learner to reinforce/explain correct performance, as well as provide an explanation of incorrect performance. Motivation feedback is used to support the learner's affect, self-regulation, and effort. Feedback is powerful; it fell in the top 5 to 10 highest influences on achievement (Hattie 1999) along with direct instruction and reciprocal teaching. According to Hattie (1999), feedback works at 4 levels: 1) task level (e.g., correct/incorrect), 2) process level (e.g., remember to use the strategy taught in the course), 3) self-regulation (e.g., go back and check to see if you completed the 3 key steps in order), and 4) self (e.g., that was a well-thought-out response, well done). All learners need feedback that at a minimum, states they are correct or incorrect. Learners need to be guided toward figuring out their mistake. To save authors' time, it may be helpful to provide sentence starters or a list of different types of feedback for the task.

It is recommended that GIFT make available more extensive stored content for reuse. If there was a pool of materials to pick and begin, it would drastically eliminate authoring time. If a free platform for content was created alongside of the authoring tool, it would increase usage and drive it into different contexts and usage. To organize stored content, it is suggested to do so by domain, curriculum, and standards. Instructors pay a fortune on premade lessons to adapt.

GIFT is a learner-centered approach to learning with games, simulations, and adaptations based on the individual. Other methods can be applied for learner-center approaches. Assessments could be in the form of a presentation that is recorded and then used for reciprocal teaching and free content use by other authors. This could then be archived based on level of knowledge the learner needs, humor, creativity, type of strategy used, and so on. For example, social media elements, such as commenting on the video or liking their video, may be a motivator for some students. Other instructional methods such as debate,

discussion, small group working sessions, jigsaw learning, and workshop style presentation opportunities are all learner-centered strategies that would create deep learning and might aid in retention. This would enable the MAT to evolve beyond assessments with associated strategies. This would also enable a flipped learning approach. Another area of extension is to provide the students an opportunity to create their own courses and have them reciprocally teach, as appropriate. Reciprocal teaching is known for comprehension of material and a deeper level of learning (Palincsar and Brown 1984). This could be supported by having the instructor available to discuss any questions the learner might have from their course when team teaching is added into GIFT. GIFT is a perfect authoring tool for this kind of learning because of the ease of use.

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Appendix A. Literature Review

A-1 Introduction

The Army is developing a framework for providing personalized, on-demand, computer-based instruction under the Generalized Intelligent Framework for Tutoring (GIFT) program. Phase 1 will focus on the development of a Motivator Assessment Tool (MAT) to enhance GIFT that adapts its motivational strategies based on individual differences. The MAT's assessment capability will identify motivation in the learner in terms of current level of motivation and types of motivational reinforcers that work best with the learner. It will build upon efforts to incorporate additional classification variables that include student personality, learning performance history, and motivational responses. Motivational responses refer to the increase of sustained effort, with the end goal resulting in a reward based on personality. Previous research has shown that personality factors are related to motivation. Similarly, motivation has been linked to the learning process. However, the intersection between personality, the motivator, learning rate, and retention has not been explored. A trainee who is shown a reinforcer based on their personality will enter a motivated state. When in this motivated state, they will learn faster because of their deeper level of commitment and engagement, and also retain information longer. While using GIFT, the reinforcer given to a person who is high in narcissism needs more frequent reinforcement than a trainee who has stable persistence during the learning task. The focus of this effort is to examine the literature relevant to the determination of the role of individual differences in motivation to learn, and the subsequent effect on motivation to learn on long-term retention.

A-2 Definition of the Problem

Motivated and engaged trainees are often in an active state of learning (Isaksen and Hole 2015). In this state, they produce a higher sustained effort to reach a goal, which enables them to reach higher learning goals (Ackerman et al. 1995; Knafer and Heggestad 1999; McCombs and Whisler 1989). In traditional classroom environments, the human teacher is able to directly interact with the student and test various strategies for motivating the student. However, in an instructorless, or instructor-reduced, learning environment such as that supported by GIFT, determining the constructs that motivate each individual is quite challenging (Blickensderfer et al. 2003). This is because a human instructor receives immediate verbal and nonverbal feedback from the student and can use this information to tailor their interaction with the student based on prior experiences. In an automated training environment, the intelligent tutor only has sensor data and its knowledge model to determine which strategies are good at motivating. There has been

research regarding the method in which an intelligent tutor can support student motivation (Sheldon 2001); however, this is still an area of need.

As stated by Holden et al. (2012; p. 4), "Increasing computer-based tutoring systems (CBTS) understanding of a learner can foster higher levels of learning by optimizing instruction based on the learner's individual needs." This project seeks to develop a MAT that will provide an automated means of determining a student's personal motivators and selecting the optimal motivational strategy for an intelligent tutor to employ during a given session. Individualizing the external motivators presented to a student has the potential to significantly improve the learning rate and retention of the trainee (Isaksen and Ramberg 2005). If the process of determining what motivates an individual student to engage in the learning process can be automated, it is then possible to develop a MAT to enable the intelligent tutor to administer strategies that motivate the student tailored to their unique preferences. The efficacy of this MAT can be measured by the increase in effort, attention, and learning during a given training session.

To motivate means to be "moved to do something" (Ryan and Deci 2000). Motivation is essential to learning (Keller 1987a). When in a motivated state, an individual is internally inclined to initiate a task and persevere throughout its completion. In essence, motivation increases an individual's level of engagement (Magill 1980), while unmotivated people disengage from the task completely or shut down. The contributing factors of motivation is based on an individual's needs, values, goals, and emotions (Locke 2000) on the reinforcer and task. Motivation can be classified into 2 types (del Soldato and du Boulay 1999; Kember et al. 1999; Noels et al. 1999): 1) intrinsic motivation, which refers to an individual's internal desire to achieve, and 2) extrinsic motivation, which refers to external rewards that encourage an individual to achieve. While intrinsic motivation is an innate trait, extrinsic motivation is a state that an instructor or automated learning environment can influence.

External motivators are essentially a reward that reinforces the individual's behavior to put forth an effort to achieve a given goal. The concepts that motivate an individual differ and could include the potential for money, recognition (e.g., grades or award), and fun. If the student extends an effort to perform well in the learning environment, those motivators become rewards upon achievement of the learning goal. An example is a student whose primary motivator is recognition. If the instructor says that a formal announcement of the student receiving the highest test score will be made, the student will put forth effort into preparing for the test. After this student receives the highest score in the class, as a result of this effort, the reward would be having the teacher announce this high score to the class. In other words, the motivator can be likened to a carrot waived in front of a rabbit to

get it to come. After the rabbit makes the effort to move and acquires the carrot, it is rewarded by getting to eat the carrot. The receipt of this reward is a reinforcement of the student's motivation, which results in motivating the student to perform in a similar, subsequent situation.

The concept of reinforcement has been used extensively, dating back to early classical conditioning experiments (Pavlov 1927). It is possible to motivate by use of a reinforcement reward to increase motivation and the related behaviors that bring the individual closer to achieving a goal (French 1955; Keller 1987a). A reinforcer is the stimulus in the form of a reward or incentive that is received after achievement of a goal. Consequently, when reinforcers are tailored to an individual's aspiration, they can reinforce motivation and the desire to achieve their goal again.

To devise an automated means of identifying an individual's motivator and translate this motivator to the real-world context within training, the whole spectrum of motivation, reinforcement learning, and reinforcers must be scrutinized. Consequently, we must review the psychology of motivation. The subjective perspective of reinforcement is split. Some researchers are for the use of reinforcers and others are cautious because of the complexity of humans. The success of reinforcers hinges on being cognizant of types of motivation, influential factors, and variations of implementation. As the development of new information about the nature of reinforcement unfolds, neuroscience offers an alternative perspective on an internal view of what happens to the body during reinforcement. This will also scope the side of learning rate and retention, as well as individual differences provided by literature. Then optimization on the link to the real-world integration of reinforcement and outcomes, as used by special education teachers, schools, in the work place, and marketing to influence an increase specific responses. Assessments used by the institutions to determine the optimal reinforcer and the classification of tools will be investigated. Once the complete spectrum is laid out, careful integration and alignment of reinforcement strategies can be determined for individualized or personalized training.

A-3 Background Research

Individuals are driven by different motivation. Some may be more intrinsically motivated and others extrinsically motivating. The psychology will be a factor in the assessment as well as classifiers. Motivation is complex because it is contextual and domain specific. Social cognitive models assess specific subject area such as math and reading and reference it to specific teachers. Some subjects need more motivation then other subjects. Also, a person's individual culture, demographic, or personality characteristics also influence motivation. Students can be motivated

in multiple ways so it is important on how and why they are motivated and not just labeling as motivated and not motivated (Linnenbrink and Pintrich 2002). Social cognitive models look at 4 key social-motivational theories: self-efficacy, attributions, intrinsic motivation, and goal orientations. (Deci et al. 1999; Eccles et al. 1998; Graham and Weiner 1996; Pintrich and Schunk 2002). They are closely associated with motivation and achievement.

A.3.1 Behavior Modification

Humans are manipulated by reward and punishment; those experiences help shape and guide us into the people we are today. This manipulation was even recognized as early as the 1600s when Locke (1632–1704) famously wrote, "Good and evil, reward and punishment, are the only motives to a rational creature; these are the spur and reins whereby all mankind are set on work, and guided." There is an extensive body of research that has provide evidence that human behavior can be modified though the use of reinforcement provided in a stimulus–response connection. A sustaining reinforcement will intensify the bond and reoccurrence of the response. If the reinforcement is displeasing, the response will decrease. As stated by Thorndike's Law of Effect, "The greater the satisfaction or discomfort, the greater the strengthening or weakening of the bond" (Thorndike 1911, p. 244). Since then we have expanded our knowledge on reward and punishment and how to begin manipulating motivation in a person. A goal of this project is to use reinforcers to promote student motivation to learn. The following provides an overview of the long history of behavior modification research.

One of the most famous historical investigations into behavioral manipulation is Pavlov's classical conditioning of reflexes (Pavlov 1927). He used the terminology unconditioned stimulus (US) for items that produced an unconditioned response (UR). He demonstrated that it was possible to train for the occurrence of the same response by manipulating the US with a conditioned stimulus (CS). When the CS is presented with the US, the resultant conditioned response (CR) is the same as the UR. However, this phenomenon is not always consistent. Sometimes expected responses do not occur or happen to a different degree with the conditioned response as with the stimulus response. The US also can result in additional responses that were not present at the start of the behavior modification effort. To address these issues, Thorndike (1911) investigated animal nonreflexive behaviors and how they can be changed.

Modification ensues based on the form of reinforcement provided in a stimulus-response connection. Thorndike's approach is that learning is the result of trial and error initially, and then from the interconnectedness of satisfaction and dissatisfaction after the response is received. One of his most famous studies

involved training cats to efficiently escape from a puzzle box. He found that cats learned from trial and error, but perceived reward when they were able to escape from the puzzle more quickly. This decrease in the amount of time to escape is known as escape latency. Thorndike attributed the decrease in escape latency due to the strengthening of the stimulus (shorter route)-response (decreased time in the puzzle). The strengthening of a bond by receiving satisfaction is known today as positive reinforcement.

Expanding on the work of Thorndike, Skinner (1911) created principles of learning by voluntary reinforcement. This reinforcement looked at behaviors beyond reflexes known as operant conditioning. His research established that the operant response is hinged on the environment to produce the outcome. As in contrast to Thorndike's instrumental conditioning, Skinner used operant learning where an animal can participate in reinforcement a multitude of times during one session. This was assessed by the response rate or amount of time reinforced in a set amount of time. He established 3 parts of operant conditioning: 1) the context of the response (positive, negative, and neutral), 2) the response, and 3) the stimulus that followed the response. Skinner defined a reinforcer as anything that magnifies the frequency of the operant response.

The reinforcement schedule plays an essential part in the response. There are continuous reinforcement and partial reinforcement schedules. Continuous reinforcement, providing the reinforcer after each response, has a fast rate of conditioning but also a fast rate of extinction. Once the outcome is achieved, there is a post-reinforcement pause before the human/animal continues with the task. When reinforcement is only provided after a certain amount of responses or a fixed ratio, which is a partial reinforcement schedule, the response rate is quick. However, the extinction rate is slower than when a continuous reinforcement schedule is used. With partial reinforcement, a variable ratio is not tied to specific number of responses but instead varies in the amount of time until the reinforcement is provided. There is less post-reinforcement pause because reinforcement could occur at any moment. When the amount of time is set, it is called a fixed interval reinforcement. The response rate is slower and there are not many real-world situations to use a fixed interval. The variable interval reinforcement has a medium response rate and a slow extinction rate. The time is varied before reinforcement occurs. Differential reinforcement rate of low rates (DRL) is given once a certain amount of time passes over the previous response. The differential reinforcement of high rates (DHR) has the fastest response time because they need to respond so many times within a set period of time. (Ferster and Skinner 1957).

Pavlov, Thorndike, and Skinner developed and tested varying approaches to using a rewards system to elicit a desired behavior, but their work did demonstrate

commonality in terms of reward systems. Specifically, rewards need to consider the context of the application and meaningfulness to the individual, or animal, whose behavior is being modified. In developing the MAT, understanding the context and meaning of the motivational strategy, as well as the reinforcer presentation schedule, will be important.

A.4 Psychology of Reinforcement

Researchers in psychology remain conflicted and inconsistent regarding the effectiveness of reinforcers. Some researchers are concerned with using reinforcers because there is the potential that reliance on the reinforcer may result in a decrease of the person's natural drive for learning. Other researchers support the use of reinforcers due to benefits they bring and that they have minimal consequences, and yet others stand that rewards are complex.

A-4.1 Rewards

To discuss rewards with respect to motivation, it is important to review the distinction between extrinsic and intrinsic motivation, as briefly discussed in the Section A-2. A person's intrinsic motivation is seen as the greatest motivational drive for a person because satisfaction and the basic needs of a person are met internally. Intrinsic motivation is fostered through autonomy and a feeling of competency. There are 3 subcategories of an individual with intrinsic motivation: they seek to know, accomplish, and be stimulated (Vallerand et al. 1992). When a trainee is intrinsically motivated to know, they look to explore and are curious. A trainee has pleasure and stagflation exploring, learning, and understanding at the same time. In a state of intrinsic motivation toward accomplishments, trainees feel satisfaction from accomplishment or creating something. The last intrinsic motivation is for stimulation. This is when a person engages for pleasure stimulation of the senses such as fun and excitement. They seek to master training techniques.

External motivation seeks to instill motivation outside of a person's own interest, such as a reinforcer. There are different types of extrinsic motivation. In varying degree from more controlling to least they are external regulation, introjected regulation, and identified regulation (Deci and Ryan 2000). In external regulation, a person is motivated by the reward. Introjected regulation occurs when the individual wants to keep their own expectations and avoid guilt even if it isn't valued or seen as fun. Identified regulation is the person value of the behavior, but still does not like it (Deci and Ryan 2000). Studies have shown a reduction of intrinsic motivation, even in an individual with high intrinsic motivation, when an extrinsic motivation strategy is used (Deci et al. 1999; Lepper et al. 1973; Tang and

Hall 1995; Frey and Jengen 2001). Using an extrinsic motivator for a highly, intrinsically motivated individual also can result in a decrease of their creativity (Kohn 1999; Pink 2011). Extrinsic motivators can be seen as controlling to the individual who is intrinsically motivated. Consequently, there is a wide range of responses for an individual who feels the external reward is controlling. This expression can appear as acceptance, impassiveness, resistance, or resentment due to individual differences. Examples of external motivators that have been observed to decrease an individual's intrinsic motivation are threats (Deci and Cascio 1972), timelines (Amabile et al. 1976), and deadlines (Reeve and Deci 1996). Consequently, if the external motivator is seen as controlling, it will undermine an individual exhibiting intrinsic motivation.

In contrast, some researchers found rewards have an increase in creativity (Eisenberger and Aselage (2009) and positive correlates to quantity and quality in performance (Cerasoli et al. 2014; Garbers and Konradt 2014) when accompanied with positive feedback and choice (Byron and Khazanchi 2012). The counter argument is negative effects from rewards are minimal when presented and applied correctly (Cameron et al. 2001). They found an increase in task interest for rewards for finishing a task, each unit solved, surpassing a score, and exceeding others (Cameron et al. 2001). In comparison, Deci et al. (1999) found a decrease on task completion and no effect on completion performance. Research has confirmed that reinforcers are ineffective in instances that learning is of high interest, tangible rewards are offered beforehand, rewards are given without success, or rewards are not dependent upon performance (Cameron et al. 2001). More recently, Hendijani et al.'s (2016) experiment found both intrinsic and extrinsic rewards increased performance and performance depending reward (money) had a positive effect on motivation and performance no matter a person's intrinsic behavior.

Thomas and Jansen (1996) propose 4 types of intrinsic rewards: 1) sense of meaningfulness, 2) choice, 3) competence, and 4) progress. However, their definition of intrinsic and extrinsic differ from those previously discussed. Specifically, they define intrinsic motivation as referring to the anticipation of the psychological rewards an individual derives from performing a task, and extrinsic motivation refers to the anticipation of task contingent rewards such as money, recognition, and praise.

There has been research regarding the role of instructional feedback on student motivation and performance (Trimmers et al. 2013). There are different types of instructional feedback, such as 1) knowledge of results (KR), in cases where student is incorrect, 2) knowledge of correct response (KCR), and 3) elaborated feedback (EF). Trimmers et al. (2013) report that KCR and EF are associated with improved learning outcomes, although the provision of this type of feedback does not always

guarantee learning success. An explanation is that KCR and EF are likely perceived by the student as positive feedback, and it has been demonstrated the positive instructional feedback leads to improved learning outcomes (Sheldon 2001). Further, Trimmers et al. (2013) conducted a study that demonstrated a positive relationship between a student's feedback seeking behaviors and their self-reported motivation as assessed with the online motivational questionnaire. Consequently, for some students, instructional feedback may be perceived as a type of reward.

A-4.2 Goals

Goal setting is a motivational strategy to increase a behavior. In the achievement goal theory, there are 2 goals: mastery and performance (Ames 1992; Elliot and Harackiewicz 1996; Elliot 1997; Elliot and Church 1997; Harackiewicz et al. 1998). Mastery goals look at "developing new skills, trying to understand their work, improving their level of competence, or achieving a sense of mastery based on self-referenced standards" (Ames 1992, p. 262). Performance goals focus on self-worth and ability. It sets the expectations on the level of performance the individual needs to achieve. Goals are more effective when they are set at the right level of obtainable objectives that challenge the individual based on their past experiences (Magill 1980). Proper matching of a reinforcer to a goal has been found to reduce frustration. Setting the right type of goals for the individual is important. Elliot et al. (2011) created the 3×2 achievement model of goals that use a questionnaire to understand the individual's needs with respect to goal setting. The 3 in the matrix is composed of 3 goal types: 1) task-based, 2) self-based, and 3) other. The 2 in the matrix is competence valence, which can either be positive or negative. The questionnaire evaluates the individual's view of the task, self, and other interpersonal skills, and the way in which those views combine with valence of positive or negative. Task-based goals are referred to as mastery of the task, such as task comprehension and percent correct. Self-based goals are a reflection the competency a person feels they possess, for example, if a person feels successful or poorly about the task compared to prior and future experiences. Other goals compare the individual's competency to others' performance. As with basic instincts of the environment, motivation results in an individual either approaching (fight) or withdrawing (flight) from a goal, as associated with positive and negative valence respectively. The task approach goal is viewed as whether the task is completed correctly, whereas the task avoidance looks at avoiding completion of the task incorrectly. The self-approach goal deals with performing better or learning more than previously achieved, whereas the self-avoidance goal focused on not performing worse or learning less than previously achieved. The other-approach goal seeks for the individual to do better than others, where the other-avoidance goal aims at a person not doing worse than others (Elliot et al. 2011). Therefore, it

is important to note that the goal for an individual is related to and is impacted by their specific motivation, and thus, supports that goals need to be framed to address individual differences. When setting individual goals based on the individual, it helps the individual meet their need for motivation. One Warfighter strives to out preform others and their goal will be written as an approach goal. The focus of their motivation is to advance passed others. Avoidance goals, is written for those who have more of a social anxiety and are motivated based on performance versus others They do not want to appear to have failed others. In wartime, trainees are motivated by different reasons—either to be the best or to not do worse than another peer. When goals are written based on their specific motivation as an individual they can relate to the reason why they are working for that goal.

A-5 Neuroscience of Memory Rewards

The term reward or reinforcer in neuroscience includes a spectrum of items including tangibles, social, motivation associated with positive and negative effects, and moving away from or toward a stimulus (Harmon-Jones et al. 2013). The parts that control decision making and goal-related behavior (Fareri et al. 2008; Schultz 2007) are in the neural circuitry, which is divided into a connection of the cortical (executive, regulatory) and subcortical (primitive and emotion areas) regions (Carlson et al. 2011; Ernst and Spear 2009; Fareri et al. 2008; Knutson et al. 2003; Mayes et al. 2009). Rewards are addressed by the basal ganglia, and more specifically, the striatum and the prefrontal and orbitofrontal cortices and their connections of corticostriatal circuits or loops. When positive reinforcement occurs, the brain is rewarded with an increase of dopamine (DA). DA is released in the midbrain in an area called the ventral striatum, and more specifically, the tiny nucleus of closely inhabited neurons called accumbens. The discharge provides a short-term effect on affect, but the activation of the DA neurons is thought to begin reinforcement learning. The DA release occurs from unexpected rewards as well as anticipated rewards, and DA emission decreases when the reward is not given. The DA discharge also occurs from the expectation and value of the reward held by the individual. The interplay of the DA and the reward related process (RL) is not fully understood (Howard-Jones and Jay 2016). However, the RL is thought to be in the ventral tegmental area (VTA), which releases the DA to various parts of the brain such as the prefrontal cortex (PFC), nucleus accumbens (NAc), amygdala, and hippocampus (Barrot 2014). Rewards also have psychological parts of liking, wanting, and learning that can be conscious or nonconscious. The firing of dopaminergic neurons may signal the want in reaching goals (Berridge 2012; Bromberg-Martin et al. 2010) and begin the seeking of the goal (Alcaro and Pankespp 2011). The DA neurons act in both a phasic (burst and firing) and a tonic (slow and irregular) manner that is thought to be involved with motivational state

(Ikemoto and Tan 2015). Phasic firing responds to reward availability (Schultz 2007, 2010) and tonic dopamine responds to novelty (Niv et al. 2007) and an overall level of motivation (Ikemoto 2007; Kaplan and Oudeyer 2007). Reward prediction error (RPE; Ernst and Spear 2009) is taken from the discrepancies between the projected worth of future rewards or punishments and their actual value. From past experiences, the brain makes predictions on the best way to react and the anticipated outcome. Learning happens when the predicted outcome is different than the actual outcome and creates an RPE. This RPE has shown consistent increase in the tonic levels from rewards and is maximized with the uncertainty of rewards (Fiorillo et al. 2003; Preuschoff 2006; Tobler et al. 2007).

Similarly, a mental model is also dependent on previously learned skills and experiences and how it was obtained. A mental model helps us manipulate problems to find difficult and abstract answers. False mental models can happen when trainees are in discovery learning (Briggs 1990) and practicing. Overlearning materials helps with creating good mental models and helps with retention. However, persistence is necessary to continue repeated practice (Driskell et al. 1992). Rumelhart et al. (1986) found that humans need to use cognitive schematas to find patterns, modeling the world (anticipation of a new state from actions they see). A learner uses their experiences to manipulate data and think logically in math problems and science.

Memory goes through the following steps: encoding, storing, and retrieving. There are 3 memory systems: 1) short-term memory, 2) working memory, and 3) long-term memory. The short-term memory stores the information for brief periods of time, whereas the working memory processes and uses the information. The working memory has the following types: auditory memory, visual-spatial memory, and the episodic buffer, which is linked to long-term memory. The visual working memory shares parts and interacts with attention (Gazzaley and Nobre 2012; Zanto et al. 2011). Short-term memory is limited in its importance to motivation, and therefore, does not add value to determining a reinforcer. However, working and long-term memory are relevant, as detailed in the following sections.

A-5.1 Working Memory

Individuals are motivated to increase their attention to receive a reward, as shown by research. Monetary rewards show a positive effect on attentional performance and response rate (Small et al. 2005; Englemann et al. 2009). Specifically, Englemann et al. (2009) used face pictures that were difficult to see, easy to see, and noise. Participants received extra money for correct responses that was on a pie chart, and had various reward magnitudes and valences. The results showed that performance increased as a result of incentive. In the Small et al. (2005) study,

participants were asked to respond to x's and not +'s in a specific amount of time. One group was given money that they could lose if they didn't meet the time, while the other group could earn money for responding fast. They looked at disengagement and visual spatial expectancy. The evidence suggested that penalties and rewards influence attention. The brain was activated in different areas based on winning and losing. The orbitofrontal cortex (OFC) was more engaged when winning and the dorsal anterior cingulate cortex was more engaged with losing (Small et al. 2005).

Some research has also shown that rewards can help an individual to ignore distractors (Della Libera and Chelazzi 2009). They found that this ability to ignore distractors is shaped by past encounters of the objects and consequences. Once the participants learned that objects were the target versus distractors, it was difficult for them to switch the target to a distractor. Rewards may also enhance performance when looking for the target with multiple distractions (Chun et al. 2011). Chelazzi and colleagues (2013) eluded that rewards potentially act as "teaching signals for learning" and enhancing attentional operations such as selecting or ignoring. The rewards could lead to faster and better visual performance. They also found that rewards increase areas of importance on visual stimuli and also suppress distracting stimuli (Chelazzi et al. 2013.) In another study, Anderson et al. (2011, 2013) paired a high and low reward with a color and were able to train the participants to view specific colors as a visual distractor. The results demonstrated that the value associated with the previously awarded stimuli interfered with performance. This provides evidence that the reward shaped the attentional signal. Chelazzi and colleagues (2014) placed high rewards and low rewards for correct responses. In this study, participants could earn the high or low reward by a specific location in one group, and they did not receive any rewards for the task in the second group. Participants were asked to find targets on the screen. In the rewards group, the participants viewed finding targets in the high reward section as a higher priority than finding the target in a low reward section. The researchers determined that reward based learning can change the priority of a special task. That result was also found several days after the learning and was generalized to a new task. Those studies show the strong connections between attention and reward, and also how attention is connected to the working memory.

Gong and Li (2014) found that learned rewards do improve the visual working memory in 3 experiments. The first experiment demonstrated that high reward (money) improves detection sensitivity over low reward. The second experiment showed that when replacing a monetary reward with a feedback reward, they did not see the difference in sensitivity detection observed in the first experiment. The third experiment showed an increase in performance for the visual working memory

when it was high reward versus low. Long-term memory is composed of 2 parts: declarative and procedural. Research has shown that rewards affect declarative memory, which is a part of our long-term memory that helps us remember experiences, facts, and verbal knowledge. Two categories of declarative memory are the episodic (personal experiences) and semantic memory (factual information). When presented with a monetary reward to recall visual scenes, the group who was given a greater reward had a higher recall of the scenes (Adcock et al. 2006). This suggests that visual working and long-term memory can be improved by manipulating attention with rewards.

The medial temporal lobe (MTL) system plays a role in creating and condensing memories, but also transferring new things learned (Cohen et al. 1997; Eichenbaum 2004; Nadel and Moscovitch 1997; Squire 1992). There is also a growing body of research suggesting the hippocampus, which is part of the MTL system, sorts out relationships of the internal states and the external environment into a person's motivation and memory that guides behavior (Baudonnat et al. 2013). Noradrenic systems are active in positive and negative reinforcement of behavior (Sara 2009). Noradrenaline also has a role in memory formation in the long-term potentiation (LTP) in the amygdala and the hippocampus (Mather et al. 2015; Sara 2009). The LTP is a model for learning and memory that is divided into early and late stages. The early stage is short term, minutes and hours, and the later stage is where memories become more permanent. The late stage requires DA for encoding (Lisman 2011). Serotonin is also interconnected, but does not seem to play a role in memory formation (Thomas 2015; Werlen and Jones 2015). However, when serotonin is decreased, impairment encoding, recall, and verbal learning occurs, although it does not impede spatial or declarative memory (Mendelsohn et al. 2009).

A-5.2 Long-Term Memory

Studies have shown that rewards make an instant influence (Wolosin et al. 2012). Other studies show no immediate influence, but yet a long-term effect because of the need to consolidate (Adcock et al. 2006) the impact of the rewards. For example, Murayama and Kuhbandener (2011) conducted a study in which participants answered trivia questions where one group received a monetary reward for correct responses while the other group received no reward. After 10 min, both groups showed no difference recalling answers, but after a week, the group that was rewarded recalled more information than the nonrewarded group. However, they observed that if the individual perceived the question as interesting, the monetary reward did not increase performance. This supports extrinsic rewards only influence a person's motivation if the task is not intrinsically motivating. In 2013,

Murayama and Kitagami demonstrated extrinsic reward enhanced memory separately from a person's attention and motivation. They concluded that dopaminergic memory consolidation was an effect of extrinsic rewards.

Rewards given with social interaction has also been investigated. There is overlap in the neural circuits and the mesolimbic brain region for social cues and reward processes (Knutson and Wimmer 2007). One study completed by Izuma et al. (2008) looked at the social aspect of having a positive reputation as a reward. For this study, money could be earned and, on a secondary task, participants received feedback about their personality. Both types of rewards activated the same brain area, which suggests that feedback triggers the same area of the brain as monetary incentives. In another study, participants had to decide whether to donate money to an organization or to keep the 5 dollars. Some of the participants had observers watching what they decided while others had no one observing them (Izuma et al. 2010). The charitable organizations were categorized by value. When the charity was considered as high value, the participant would donate with or without the observer present. If the charity was valued low, the participant would not donate even with the observer. When the charity was of a moderate value, the participants were not consistent in deciding whether to donate or keep the money. Functional magnetic resonance imaging (fMRI) showed that activities for decision making were dependent upon observer presence. This shows that social approval activated the same location that monetary rewards did (Izuma et al. 2010). Another group of researchers also looked at the effect on giving to a charitable donation versus keeping money for themselves. The results showed that donating led to higher activity in the ventral striatum then receiving money (Moll et al. 2006). This may be due to the perceived social impact of donating the money.

A-5.3 Summary

Every person is different and memory enhancement from rewards might be dependent upon an individual's value, selectivity, and prior experiences with rewards that leads them to be satisfied. Individuals are unique down to our genetic makeup. It has been observed that there are differences in performance based on the amount of DA released. Small amounts of DA have seen an increase in performance and large amounts of DA resulted in a decrease of performance (Wittmann 2011). An inverted U appears from the dose of reward given (Apiitz 2013) and individuals fall at different places for the baseline. The literature is not very extensive on how rewards (reinforcers) affect a person's memory. As stated by Miendlarzewska et al. (2016, p 157), "To our knowledge, this is the first effort to integrate the far-reaching effects of reward motivation on learning that span phenomena never considered before, including-value generalization through

perceptual similarity or various forms of associative learning, as well as the impact of reward motivation transfer in memory recollection and transformation." They also mention that there needs to be more research completed with individual personality traits, such as questionnaires and the linkage to dopamine and memory. This project may, therefore, investigate the linkage between memory and brain activities governed by dopamine, as well as the adrenaline/noradrenaline system and the process to use this linkage to determine the best intervention for increasing their motivation.

A-6 Education

The best source of current practices for determining a motivational tool matched to a learner comes from special education. Special education teachers acknowledge that a student's motivation is maximized by different outputs. Reinforcement inventories guide motivator selection. Correct identification of motivators for individuals has been proven to increase goal attainment with students who are autistic or have other social and emotional deficits. Some students apply more effort if they receive peer approval. Others feel the need for adult approval. Tangibles are defined as things they can hold such as food, money, prizes, and stickers. Others thrive on competition. Many want free time away from the task or the use of technology for entertainment.

Applied behavior analysis (ABA) has been used with students who are autistic to evaluate their responses to different motivational strategies. ABA continuously monitors and graphs the effectiveness of motivational strategy (operant behavior) on the student's motivation (respondent behavior), and the results are used to modify the motivational strategy. Reinforcer inventories are used to find the value of reinforcers for individuals based on things they prefer and do not prefer. Operant behavior is selected based on the results of a history of consequences and it is maintained by the consequence the behavior brings. Reinforcers are preferred events if they increase the chance for the behavior to occur again. The reinforcement from the reinforcers can be either positive or negative reinforcement. Negative is seen as escape and avoidance. For example, a person wants a break away from a difficult task if it is perceived as a negative reinforcement.

There are different types of reinforcers (Cooper et al. 2007; Newman 2003). Primary reinforces are naturally occurring, such as food, water, sleep, and temperature; and secondary reinforcers are paired with a primary reinforcer, such as food provided with a token. Secondary reinforcements after repeated pairing with the primary, becomes a primary reinforcer (e.g., grades, money, praise, strength, rank). The identification of reinforcers that motivate a person is important for its effectiveness. Methods for determining the optimal reinforcer in educational

settings include directly asking the student, observing, using the Premack principle, sampling, or reinforcer preference assessments (Ryan 2011). The Premack principle refers to cause and effect relationships (e.g., if you do this, then this will happen), such as if a child gets an A on the test, then they can ride their bike. A reinforcer or preference assessment evaluates a student's preferences. When using a reinforcer, avoid satiation (when reinforcers no longer are effective) by using a selection of reinforcers and small amounts. Only allow the reinforcer to be given once the target is met and vary the pace of the reinforcer. Vary the tone of voice when feedback is given with the reinforcer and use specific and varied feedback to make it fun (Ryan 2011).

Special education teachers also conduct functional behavioral assessments (FBAs) to create individual behavioral intervention plans (BIPs). FBAs are the most effective intervention for changing behavior in the classroom (Ingram et al. 2005; Blood and Neel 2007). The plan begins by developing a goal that is observable and measurable with no "fuzzy" terminology (Mager 1972). The success is driven by a clear hypothesis that has 3 parts: antecedent, behavior, and function of the behavior. Then execution steps are developed. Reinforcing the individual antecedent is important for success of the interventions. A flowchart is created for identifying the problem, which takes one of 2 directions: either a student is avoiding something (attention, unwanted task or item, sensory input) or desires something (attention, activity or item, or sensory input; Taylor and Abernathy 2016). In the case of avoidance, replace the behavior with something acceptable. To do this, remove or add a desired task (negative reinforcement) or object (positive reinforcement). If they seek attention or activity, weaken the problem by removing any reinforcement of negative behavior (extinction) or take away desired task (response cost).

Another method, positive behavioral supports (PBSs), originally only applied to students with extreme social disabilities, has been made available for all students to better optimize learning. PBS has its foundations in operant conditioning, in which students are rewarded for positive behaviors. When PBS, rules and expectations need to be clear, and the rewards system is based on the individual student's interests. It is recommended with PBS that reward systems include praise or feedback, as well as a token economy (McKevitt et al. 2012).

A-7 Workplace

Rewards in the workplace are also seen to increase performance. Compensation and incentives—individual, competitive, or cooperative—have been used by companies to improve performance, behavior, and motivation (Guzzo et al. 1985). People will work for rewards and to avoid punishment, and will neglect what is neutral (Kerr 1975). In the workforce, it is important to align the rewards with goals

and outcomes (Kerr and Slocum 1988). When developing a reward plan, it is important to keep in mind the benefit to the employee when they reach the desired outcome (Rothwell and Kanzanas 2008). This is also the first question that instructional designers ask when creating a reward system. For the system to work, a person must be able to reach success and feel competent, they must believe they will actually receive a reward, and they must value the reward. As in education and psychology, rewards need to be designed intentionally, controlled by others, and understand the reward-achievement relationship. Instructional designers see 4 goals for rewards: attracting people to an organization, keeping people with the organization, modifying behavior a certain way or increasing creativity, and increasing achievement for work results. They classify rewards into 2 categories: monetary and nonmonetary incentives (Rothwell and Kanzanas 2008).

The workplace recognizes that individuals respond differently to incentives (Wageman and Baker 1997). As seen in the workplace, individuals who work independently, competitiveness is seen as an effective incentive. Alternatively, cooperation incentives are effective group tasks (Zingheim and Schuster 2000; Wageman 2006). The reward needs to fit the individual, and their attitudes and inclinations. Money has a proven positive effect as a reward in the United States and other countries (Du and Choi 2010). Monetary rewards can increase productivity by 30% (Locke et al. 1980). However, the workplace is also cognizant of how external rewards can decrease intrinsic motivation (Eisenberger and Cameron 1996). Large amounts of money can fail to motivate (Beer and Cannon 2004), they can lead to a decline in performance for fear of failure (Chib et al. 2013) and increase expectations on payouts (Beer and Cannon 2004). Bari et al. (2013) found that nonfinancial rewards can increase attitude and performance in the workplace. They found a positive impact on feedback, freedom, career development plan, valuation of employees, learning programs, open and comfortable work environment, and good supervisory relations.

A person's personality and motivation in the work place is a "key mediating mechanism" (Hogan 1996; Kanfer and Ackerman 2000; Hogan and Holland 2003; Barrick and Mount 2005) and found that personality can influence a person's choice and their effort. Schneider's (1987) attraction–selection–attrition (ASA) model states that people are attracted to environments that are similar to themselves. Extraverted people are driven to places where people are animated and talkative. This is similar to research in a learning environment that finds extraverted individuals prefer social learning environments, such as a group training environment or classroom, while introverted individuals prefer computer-based training that is isolated from other people (Odum and Pourjalai 1994). Research has also proved this concept of personality influencing the environment they pick

(Barrick et al. 2003; Judge and Cable 1997; Schneider et al. 2001). Barrick et al. (2003) found that other Big 5 dimensions are related to work performance and motivation. Emotional stability is connected to accomplishment and goal-orientation based on high and low emotional stability.

The lure of rewards surrounds society, from credit cards promoting their card and rewarding with points to use later. Banks try to open a savings account for free cash. They have begun tailoring their cards and rewards to individuals, such as the "GE Capital Gains Card" that rewards for saving with entertainment and travel that is given if a person conforms to the behavior for the card (Walker et al. 2000). These are just a few of the many ways that businesses and the workplace are utilizing reinforcers.

A-8 Individual Differences

An individual difference is a broad term that can refer to variables such as personality, intelligence, physiological makeup, and prior experiences. The Navy conducted a literature review on individual differences that have an impact on training outcomes. The differences that have an impact on outcomes are intrinsic motivation, a person's motivational drive to learn, goal setting capabilities; a person's values and beliefs, personality differences, organizational commitments and perceived fairness, and attitude on training all were found to have an impact on training outcomes in a literature review (Schultz et al. 2011). This section attempts to briefly review various individual differences that may be beneficial for inclusion in the MAT.

A-8.1 Age

The generation a person is born in can affect their motivational drive. Matures born in 1922 to 1945 value conformity and sacrifice, but do not like change (Clare 2009). Baby Boomers from 1946 to 1963 value personal growth, but are idealist (Clare 2009). Generation X are born from 1964 to 1980s are more literate in technology, but are also more independent and place their needs in front of their jobs (Clare 2009). Generation X also sees goal orientation as a primary factor in job satisfaction and intention to remain, but not so for Baby Boomers (Westerman and Yamamura 2007). The Millennials were born in the early 1980s to 2000 and are more sociable, street smart, have a passion for learning, but expect rewards and lack loyalty (Clare 2009). They are habituated to positive praise and cannot handle negative feedback efficiently (Sujansky and Ferri-Reid 2010). Simons and Simons (2010) also found that younger workers strongly value extrinsic rewards, but also are not as willing to work longer hours to achieve the reward. The younger population values leisure and time away from work. In another study by Ng et al. (2010) researched on 23,413

millennial undergraduate students in Canada. Millennials rated opportunities for advancement as the most desirable attribute, second was working with and reporting to good people, third was training opportunities, and fourth was work–life balance. Salary fell ninth on the list (Ng et al. 2010).

A-8.2 Self-Efficacy

The attribution theory wants to know why events occur. Finding out a person's behavior and the reason for the behavior connects to success (Graham and Weiner 1996). When a person is successful or fails they look for a reason (Weiner 1986). The person could believe failure is from environmental (distractions, teacher) or personal factors (ability, preparation). Perception of failure or success is derived from 3 dimensions: stability, locus of control (internal or external), and controllability. These events feed into a person's self-efficacy and can be influenced by feedback (Lincht 1983; Pintrich and Schunk 2002). Identifying the exact cause of the failure or success, such as a lack of effort or not having an appropriate strategy, should be considered when providing feedback.

A person's self-efficacy is a belief about a person's capability to do a task or activity in a specific context or domain (Bandura 1997). Self-efficacy is based on past successes and failures on specific types of tasks. A person with high self-efficacy tends to have higher levels of achievement and an increase in persistence on difficult tasks (Bandura 1997; Pintrich and Schunk 2002). Self-efficacy is also related to other positive outcomes like choice, persistence, cognitive engagement, use of self-regulatory strategies, and actual achievement, and applies to all ages, gender, and ethnic groups (Bandura 1997; Pintrich and Schunk 2002). It is fostered through success and specific praise (not meaningless). Allowing for choice on the type of assessments to complete can enhance self-efficacy through choice based on previous successes. Placing self-efficacy in tutoring systems has started to be explored through students using a meter about their ability to answer the problem successfully, as well as using a static self-efficacy model from a pretest (McQuiggan and Lester 2006). The intelligent tutor can assist in creating positive affective states based individual motivators that effect learning such as effectiveness, transfer, persistence, and increase in effort (Zimmerman 2000) because of the satisfaction and value matches the individual's needs.

The regulatory focus theory (Higgins 1998) addresses individual self-regulatory differences. Personality plays a role in the regulatory focus of individuals (Lanaj et al. 2012). Some individuals are motivated by their own personal hopes and advancements (promotion focus), and thus aim at positive goals. Others are motivated by finishing their responsibilities (prevention focus). People who fit into a prevention focus are more aware of risk, safety, and avoid errors (Halvorson and

Higgins 2013). In contrast with the Big 5 (Digman 1990), regulatory is closely linked with behavior. Promotion focus is linked with production performance (Wallace et al. 2009) and sensitivity to the presence or absence of rewards (Kark and Van 2007). Another meta-analysis by Condly et al. (2003) found that incentives increased performance by 22% compared with companies who did not implement an incentive plan. Promotion focused people are easier motivated by individual incentive schemes and prevention-focused are more sensitive to group incentives (Beersma et al. 2013).

A-8.3 Personality

The interaction of personality traits and learning environments/strategies impacts learning outcomes (Blickensderfer et al. 2003; Komarraju et al. 2011). Additionally, personality traits have been associated with cognitive, affective, and motivational processes (Matthews and Zeidner 2004). The Big 5 traits have been connected to behaviors, academic achievement, and job performance (Costa and McCrae 1992; Judge et al. 2007).

The Big 5 (Goldberg 1981) is one of the more commonly used personality theories for educational psychology (Dingman 1990; Costa and McCrae 1986). The following are the Big 5 personality traits:

1. Extraversion or introverted
2. Agreeableness
3. Conscientiousness
4. Neuroticism
5. Openness

If a person has high extraversion they are more social and talkative. If they are low extraversion (e.g., introverted), then they are more reserved. Some researchers have associated extraversion–introversion with the "level of activity in the corticoreticular loop," such that introverts are more cortically aroused than extraverts" (Eysenck and Eysenck 1985, p. 197). In other words, introverts have a low threshold for stimulation, whereas extraverts have a high threshold for stimulation. This means that for extraverts, increased arousal results in increased performance, while with introverts, decreased arousal results in increased performance (Eysenck and Eysenck 1985; Matthews and Deary 1998). Consequently, extraverts are considered to be superior to introverts in performance in high-arousing environments, as well as view social activities as rewarding (Matthews and Zeidner 2004). Introverts are seen as studying and a positive to

academic achievement (Poropat 2009). Extraverts are seen as socializing more and not studying as much and can have a negative result on academic performance (Rolfhus and Ackerman 1999).

People who are more agreeable are more cooperative and those who are less agreeable are competitive and sometimes manipulative. Agreeableness is seen as a positive trait for academic performance (Lounsbury et al. 2003; Farsides and Woodfield 2003). Agreeableness is seen as people who are willing to put their own interest after others. They are helpful to others, have self-control, and positive on others (Ahadi and Rothbart 1994; Cumberland-Li et al. 2004). They have been found to be compliant, soft-hearted, and trusting (McCrae and Costa 1999).

Conscientiousness is exhibited by a person who pays attention to details, is organized, and is goal directed. Conscientious individuals tend to be self-focused and self-governing (Hmel and Pincus 2002). They are also responsible, reliable, and dependable (Costa and McCrae 1992). They are found to set work goals for themselves and have a commitment versus individuals who scored low (Barrick et al. 2003). Conscientiousness has been linked to GPA (Conrad 2006; Komarraju 2011) and is a predictor of academic success (Blickenderfer et al. 2003; Dollinger and Orf 1991; Furnham et al. 2003; Paunonen and Ashton 2001). A person that is low on contentious research has shown that they are more likely to procrastinate on a task (Steel 2007).

Neuroticism deals with emotions. Individuals with high neuroticism have a greater level of emotions such as stress, anxiety, irritability, or sadness. If one is low on neuroticism, then they are more stable with their emotions (McCrae and John 1992). Some researchers attribute this to "individual differences in excitability and emotional responsiveness, which are reflected in autonomic activation" (Eysenck and Eysenck, p. 232). Neuroticism has been characterized by working memory deficit and pessimistic outlook leading to negative reactions to demanding environments, emotion focus rather than task-focus, and low self-esteem (Matthews 1999). Across all types of neuroticism, coping strategies appear to be related to the particular environment in which the individual is operating, which suggests that the MAT should assess an individual's comfort in a given situation or environment. This is consistent with Matthews and Zeidler's (2004) view of personality having both fixed traits as well as dynamic states, which are dependent on the specific environment. High neuroticism is deemed hurtful in academic performance (Chamorro-Premuzic and Furnham 2003). Introjected motivation was positively related to neuroticism when looking at personality and motivation relationship (Phillits et al. 2003). Emotional stability has been linked with self-efficacy motivation (Jedge et al. 1998)

Openness allows a person to have more interest and creativity. Individuals low on openness are traditional and may not like change or abstract thinking. Openness is correlated positively with academic performance (Lounsbury et al. 2003; Farsides and Woodfield 2003) and intellectual curiosity (Komarraju et al. 2011).

Komarraju and Karau (2009) looked at the links between Big 5 traits, academic motivation, and academic achievement. The results showed that conscientiousness was the most influential and had relationships with all the variables: intrinsic, extrinsic, amotivation, and GPA. They had higher scores on both intrinsic and extrinsic motivation had the lowest amotivation and the highest achievement. Agreeableness and openness were more connected with achievement. People who had higher intrinsic motivation also had higher tendencies toward openness. Neurotic individuals were seen to have a higher amotivation. The results showed that personality traits effect motivation and achievement. It also suggested that conscientious students who are organized and disciplined are more motivated. Extraversion was related with extrinsic motivation and conscientiousness was not associated with amotivation. Similar results were obtained in related study in 2011 (Komarraju et al. 2011). In summary, there is sufficient evidence that there is an interaction with an individual's personality traits, preference to a given environment (e.g., situational context) and motivation. Specifically, this interaction demonstrates how an individual's personality traits may predispose them to view certain types of tasks as rewarding—or punishing. If the MAT is able to determine both an individual's personality traits and preference for the specific learning task/environment, this information can be used to recommend a motivator that will be viewed as a reward.

A-8.4 Value

A person's values are relatively stable over time. They are what a person finds important and it is a motivation to a person. It is in essence a long-term goal that stands in different context and points of time. (Schwartz 1997; Schwartz and Bilsky 1990). Schwartz value theory has 10 basic values for humans: power (social status, control, dominance), achievement (successful, capable, ambitious, influential), hedonism (pleasure and enjoyment for yourself), stimulation (excitement, novelty, challenge), self-direction (creativity, freedom, independent, choosing own goal), universalism (wisdom, equality, peace, protecting), benevolence (helpful, honest, forgiving, loyal, responsible), tradition (religion, tradition, customs), conformity (politeness, obedient, self-discipline, honoring elders or parents), and security (family and national safety, clean, orderly). Schwartz made broader values openness to change, self-enhancement, self-transcendence, and hedonism. This has been linked to personality traits. A person's values and traits are linked by our

temperament we are born with and so value may affect traits and traits may affect values. Extraversion correlates positively with stimulation, achievement, and hedonism and negatively to tradition values (Roccas et al. 2002).

A-8.5 Individual Differences Rewards Used in Learning Games

In video games, which is perceived to be intrinsically motivating, creators also a need to incorporate extrinsic rewards for individual differences such as a task that might be seen as boring (Schneider 1987). Rewards used in games are thought to be intrinsically motivating because they are fun and enjoyable (Robson et al. 2015). Some motivational strategies used in games (Hamari et al. 2014) are points, leaderboards, achievements/badges, levels, story/theme, clear goals, feedback, rewards, progress, and challenge. Evidences shows that rewards used in games are motivating in game-based learning (Jabbar and Felicia 2015).

In a search on all reward systems used online and on apps based on research, Lewis et al. (2016) found that the most widely used reward system was with points (Caffazzo et al. 2012; Agoristas et al. 2014; Allam et al. 2015; Boendermaker et al. 2015). Points were used on 55%–73% of apps on Apple (Lister et al. 2014; Payne et al. 2015). The next most popular were the use of achievements/badges/medals that are given when the behavior is changed or meeting a level. Agoritsas et al. 2015; Allam et al. 2015). The next popular were tangible rewards where people receive credit to the iTunes store stickers, ribbons, or medals on a game board and other tangible rewards. Other rewards that were popular were currency, likes by others (on social media posts), animated feedback, and kudos (virtual gifts that could be shared). However, none of the studies reported on the effects of the rewards on desired outcomes. Lewis et al. (2016) placed them with taxonomy: points, achievement/badges/medals and animated rewards were for glory (Hallford and Hallford 2001). Kudos and likes were social rewards (Rigby 2009), currency like power-ups (Kamel et al. 2015) or game progression (Jones et al. 2014).

Research on personality differences and video games found that extraversion is connected to relationship, adventure, and achievement motivation, agreeableness to escapism, achievement motivation (Park et al. 2011), and competence motivation (John and Srivastava 1999). Openness has been linked to motivation for autonomy (Johnson and Gardner 2010). Motivation impacts intrinsic motivation that makes it enjoyable and could change the reward selection based on differences. Personality traits are also connected with reward preferences. Conscientiousness and openness have been associated with greater preference for rewards (Karanam et al. 2010) and extraversion is motivated to achieve rewards in goal-directed activities. Unfulfilled needs is associated with preference of rewards which is linked to neuroticism,

conscientiousness and agreeableness. A person who is easily bored needs more short-term goals (Staewen et al. 2014).

Research has been started on individual differences and reward selection. Some motivational strategies used in games (Hamari et al. 2014) are points, leaderboards, achievements/badges, levels, story/theme, clear goals, feedback, rewards, progress, and challenge. Karanam and colleagues (2010) found that participants who had high conscientiousness and openness preferred rewards, participants who were high on extraversion and openness liked challenges and missions. These anecdotes are consistent with the description of these personality traits applied to learning that was previously discussed.

Nagle et al. (2016) used performance-contingent rewards (round in a certain time frame), task-contingent rewards (completing a round), and no rewards. The awards were given with points and animation. The Big 5 Personality traits were assessed a priori with a questionnaire and their intrinsic motivation was measured by their task performance. The study showed that openness and extraversion predicted intrinsic motivation and performance in performance-contingent rewards. Extraverted individuals found rewarded based on performance appealing because they are achieving. They also found that openness has been related to wanting autonomy in games (Johnson and Gardner). Neuroticism is liked to short-term rewards (Manning et al. 2014) and was seen as negative for task-contingent rewards since they didn't need to perform to be awarded often. Effort was seen through conscientiousness for both kinds of task (performance-task). Extraversion wasn't effected by rewards. This study showed that reward selection is different based on different combination of personality traits.

A-8.6 Summary

Different people place different values on rewards and it is important to find individual differences to place a perfect match. Personality is an individual differences variable that affects whether they perceive an activity as a motivator. There are different ways a person can measure personality such as the Big 5 model of personality (Wiggins and Trapnell 1996). The Big 5 is one of the most common models to deal with personality that has been used in research pertaining to motivation and learning and is measured by questionnaires. With respect to the MAT, this research suggests the possibility of creating a set of reward recommendations that are linked with personality traits. For example, if someone is extraverted, a reward may be the opportunity to use social media in conjunction with their learning activity.

In summary, to better understand an individual's needs with respect to increasing their motivation requires an understanding of their personality traits. This will aid in projecting how a specific motivational strategy may be perceived and whether it will be useful.

A-9 Physiological Measures

Physiological and behavioral indicators of motivation measure objectively during and instructional session to identify changes in the students' affect that can reflect their motivational state. These types of measures can provide objective insight into how a student is responding to a specific motivational strategy without potential effect of self-report tending to reflect a more positive response than actually experienced (Woolf et al. 2009). The use of these types of measures to make inferences regarding the effectiveness of a reinforcer requires comparing their responses while receiving the reinforcement to a baseline measure taken prior to the start of the instructional session.

Specific physiological measures that can provide insight on motivational state include skin conductance, heart rate (including cardiac variability and interbeat interval [IBI]), electromyogram [EMG], and muscle tension), and electroencephalogram (EEG; brain activity). Skin conductance, heart rate (HR), and skin temperature evaluate autonomic nervous system activity, specifically the sympathetic (SNS; controls activity when energy is expended) and parasympathetic (PNS; controls activity during periods of rest) nervous systems (Andreassi 1995). EMG provides a measure of somatic nervous system activity, and EEG provides a measure of CNS activity. Table 1 summarizes the information that can be gleaned from real-time physiological measures during an instructional session.

Table A-1 Physiological measure overview

Physiological measure	System	Affect type
Skin conductance	SNS	Arousal, engagement, boredom
Heart rate	SNS	Arousal, engagement, fear
	PNS	Stress, frustration, anxiety
EMG	Somatic	Stress, frustration
EEG	CNS	Workload, engagement

Evaluation of changes in HR can be used to evaluate changes in arousal, with increased HR indicated increase arousal due both positive (e.g., engagement) and negative (e.g., fear) emotion, as well as distress with a sudden decrease in HR related to emotions such as sadness or disgust. It has also been recommended that HR increases are more reflective of mental workload (Grossman 1992), and therefore, could indicate that the student is extending effort or engaged in their

learning task. HR variability describes the variability in the interbeat interval, or periods between heart beats, and has been used to evaluate changes in emotional responding (Appelhans and Luecken 2006). HR data are typically collected using photoplethysmography (measure of blood flow volume) or electrocardiogram (ECG). Similar to skin conductance, HR data can be obtained through minimally invasive sensors, which use photoplethysmography. Personality differences should also be considered in evaluating HR responses. For example, individuals high in neuroticism, who have a tendency to negatively interpret the environment, may exhibit greater changes to the presentation of a reinforcer or feedback than those lower in neuroticism (Fichera and Andreassi 2000).

It has been demonstrated the increased EEG activity is associated with increases in arousal (Bradley and Lang 2000). EEG has also been used to evaluate student workload and engagement (Berka et al. 2007). While EEG devices may be undesirable due to the requirement for wearing sensors attached to one's head, the technology is progressing so that it is more user accepted. Additionally, when thinking of learning in a virtual reality (VR) or augmented reality (AR) enabled environment, the integration of EEG with an AR/VR headset may be a more realistic solution.

Behavioral measures can also provide another source of real-time assessment of change in affect in response to triggers such as the provision of a reinforcer. Eye blink rate (EBR) has been associated with dopamine DA release, with increased eye blinks associated with increased secretion of DA and a decrease in eyeblink activity associated with decreased DA secretion (Slagter et al. 2015). As discussed in the prior section, increases in DA secretion have been associated with positive rewards, whereas decreases in DA occur in response to negative rewards/ punishment (Daw and Shohamy 2008). Pupil dilation and eye tracking (Conati et al. 2013) have been used to evaluate student engagement and recommended for adaptive learning environments. Finally, other behavioral measures of motivation include speed or response rate to answering questions or performing a task, in which increased speed indicates increased motivation (when the task is performed well), and performance of the task itself (Touré-Tillery and Fishbach 2014).

A-10 Assessments Classifications

We have discussed how a reinforcer can increase motivation, visual attention, and retention. Now let's focus on how to measure current level and changes in student motivation and determine how an individual's personality profile.

A-10.1 Motivation Rewards

In the review of literature, motivation is primarily measured the following ways: 1) cognitive measures (recall), 2) subjective self-reports that ask how satisfied the individual feels, 3) behavioral/performance assessment, and 4) physiological measures (Toure-Tillery and Fishbach 2014).

Another means of assessing motivation is to evaluate an individual's progress in meeting goals that they have set or have been set by an external system. Goals can be assessed by evaluating an increase in time on a task, which can indicate that the individuals are focused and more conscientious about getting the answer correct with a deeper level of learning. Conversely, a decrease in time to complete can indicate a decreased level of motivation due to a lower level of engagement resulting in the amount of time and effort expended on a task. However, it's important to determine the context of a situation. For example, if there's a time constraint for completing a task, a decrease in time could be an indication of high motivation if the individual is focusing on achieving the time sensitivity goal associated with the task. The Patterns of Adaptive Learning Survey (PALS) has been used in a variety of cultures and ages (Midgley et al. 1998) to assess achievement of goals and the individual's type of orientation toward the goal.

There are assessments for both intrinsic and extrinsic motivation, which describe how a person is motivated based on the context or particular topic or even in general. One example is the Harter (1981) self-report scale of intrinsic versus extrinsic motivation. This scale measures intrinsic versus extrinsic motivation in the classroom, with 3 scales assessing motivation (preference for challenge, curiosity/interest, mastery) and 2 scales assessing cognitive-informational structures (such as independent, judgment, internal criteria). Another examples are the Intrinsic Motivation Inventory (IMI; Ryan, 2007) used to evaluate intrinsic motivation and self-regulation. The IMI comprises 45 items that make up 7 subscales, and it is administered post-task. Barron and Harackiewicz (2001) have investigated intrinsic motivation with questions regarding items that the individual likes or enjoys. Situational interest, which considers the context of the task, has also been considered (Harackiewicz et al. 2000).

The AMS-C 28 (Vallerand et al. 1992) is a 28-item measure of academic motivation used to determine reasons why students attended college. Its 7-factor structure is based on Deci and Ryan's (1985) self-determination theory. The 7 subscales comprise a) 3 measures of intrinsic motivation: intrinsic motivation to know (IM to know), intrinsic motivation toward accomplishments (IM to accomplish things), and intrinsic motivation to experience stimulation (IM to experience stimulation); b) 3 measures of extrinsic motivation: identified regulation, introjected regulation,

and external regulation; and c) amotivation. Although each subscale is measured by only 4 items, the reliability and validity of the AMS-C 28 has been established with measures of internal consistency, test–retest reliability, concurrent validity, and construct validity (Vallerand et al. 1992).

The Instructional Materials Motivation Survey (IMMS) is a self-report based assessment to for evaluating how students view the instructional content itself as motivational or amotivational based on the ARCS model of motivation (Loorbach et al. 2015). The ARCS model (Keller 2010) as described previously assumes that motivation is dependent upon 4 interrelated constructs: attention, relevance, confidence and satisfaction. The IMMS is a 36-item survey used to assess the effects of instruction on a student's motivation. The IMMS—as well as ARCS—was developed with a traditional classroom based instructional setting in mind, with most validation studies of the IMMS being completed in a classroom setting. Additional researchers have evaluated its use in the context of self-directed, technology-based learning, such as validation of the IMMS in a self-directed instructional setting aimed at working with technology (Loorbach et al. 2015; (Huang et al. 2010; Huang and Hew 2016). The results of Loorbach et al.'s validation of the IMMS, and the Reduced IMMS (RIMMS), suggest that the 12-item RIMMS more accurately assesses student motivation in a self-regulated, technological learning environment. Huang and Hew implemented an online version of the IMMS to evaluate learner motivation levels during enrollment in a massive open online course (MOOC). Another self-report questionnaire is the online-motivation questionnaire (OMQ), which specifically evaluates amount of effort a student plans to expend on a task (Trimmers et al. 2013). The authors used 3 of the 7 dimensions the OMQ assesses (task-value beliefs, success expectancy and effort) to evaluate the effect of instructional feedback and students interest in the feedback on their motivation and learning outcomes.

The input–environment–outcome (I-E-O) model is an analysis method for assesses how student internal characteristics (inputs) and external (environment) variables impact a student's learning (House 1999)—with internal characteristics including intrinsic motivation and external variables including rewards or other motivators. House used the I-E-O assessment model to evaluate the interaction of student internal characteristics (high school GPA, self-rated academic ability and expectations of graduating with honor) and learning environment variables (hours/week study time, participation in a group project, work outside of college and commute time) on learning outcomes (student satisfaction with their college and completion of bachelor's degree). The analysis method comprises 3 steps: 1) correlations between the input and environment variables, 2) correlations

between input/output and outcome measures, and 3) Causal Analytical Modeling via Blocked Regression Analysis (CAMBRA) to evaluate the overall model.

Self-efficacy is assessed through questionnaires. The MSLQ (Pintrich et al. 1993) and PALS (Midgley et al. 1998) include measures to assess self-efficacy through questions that the that the individual rates on a 5- to 7-point Likert scale.

A-10.2 Grit

Grit is a person's ability to persist at a lifetime or long-term goal either professional or educational despite failures and challenges (Duckworkth and Quinn 2009; Vallerand et al. 2014). A person with higher grit is more effective (Robertson-Kraft and Duckworth 2014). They tend to practice more because of their intrinsic passion and it shows in their level of skill and performance (Vallerand et al. 2014). It is assessed using self-reports or questionnaires such as the Brief Grit Scale (Duckworth and Quinn 2009). The Grit Gauge (Stoltz et al. 2016) assesses a person's growth, resilience, instinct, and tenacity and robustness. A person's growth is a person who seeks for new ideas/ways, resilience is how one deals with challenges, instinct is finding one's path to the goal in the best/right way, and tenacity is one's persistence. The robustness is how a person deals with challenges over time (Stoltz et al. 2016). It is closely related to the personality trait of conscientiousness and related to academic achievement (Duckworth and Quinn 2009). Grit is seen as a part of conscientiousness because the person is self-dutiful and achievement oriented. (Duckworth et al. 2007).

Schools have reinforcement assessments used to try and find the perfect match for a reinforcer. One that is widely used is the Dunn-Rankin Reward Preference Inventory (DRRPI; Cartwright and Cartwright 1970). The DRRPI classifies the rewards into adult approval, peer approval, tangible rewards, competition, and independence. Cartwright and Cartwright (1970) report of a study demonstrated that the DRRPI was a valid indicator of reward preferences for the primary-age learning disabled students but had limited uses for all students in the classroom. It is used in schools, but there is very little to no literature on the DRRPI. Similar to the DRRPI, the forced-choice survey asks students 2 sentences and they have to pick the statement that identifies the reward they would prefer (Gable 1991). Schools typically used the forced-choice survey in conjunction with the Positive Behavioral Intervention Schools survey. This latter instrument classifies motivation based on a measure of adult approval, competitive approval, peer approval, independent rewards and consumable rewards. There is no literature about the validity of the test but it is used in schools.

Other inventories such as the Behavioral Assessment Guide (ABA-Instituut 1993) is used to determine both children and adult reinforcement preferences. It is rated on a scale from not at all to very much. The children's section is broken into food items, toys and playthings, entertainment, sports and games, music, arts, crafts, excursions, and community events that could be reinforcing. It also evaluates how social interaction, academic/classroom, domestic activities, personal appearance, token reinforcers, and other possible reinforcers are perceived by the student. Then, the student list activities they do multiple times a days and how much time. For adults, the Behavioral Assessment Guide examines different variables under entertainment, hobbies, food, beverages, sports, excursions, social, helping, books and magazines, and personal appearance. Then it asks how long a person likes to do things like watch TV, sleep, read, be alone, or with others. This information is used to determine the types of rewards likely to encourage motivation.

A-10.3 Personality

With respect to assessing the Big 5 personality traits, the 10 Item Personality measure (TIPI) is a short form assessment of personality with only 2 items per each Big 5 trait (Gosling et al. 2003). Another instrument for assessing the Big 5 personality traits is the International Personality Item Pool (IPIP; Goldberg 2016). There is a more extended version that considers more traits than the Big 5 such as humor and toughness, called the AB5C Model of Personality. Other inventories have been the NEO 5 Factor Inventory (NEO-FFI: Costa and McCrae 1992) that uses a 5-point scale on the 5 factors there is also the Eysenck Personality Questionnaire-Revised Short Form (EPQ-R Short Form; Eysenck, Eysenck, and Barrett 1985).

A-10.4 Games, Motivation, and Assessment

Other classifications from games we know that players need rewards for advancement cooperation/compete, review, sociality. Players like to review their rewards and they like to share about their rewards (Wang and Sun 2011). Others games classify by relationship, adventure, and achievement motivation, agreeableness to escapism and achievement motivation (Park et al. 2011) and competence motivation (John and Srivastava 1999). Games have been used for a variety of applications from training, learning, and rehabilitation. Rewards in games can be long and short term, and are administered as a high score, animations, feedback messages, and so on. These are based on different characteristics of people or player type. (Staewen et al. 2014). Rewards and goals are important in computer games (Salen and Zimmerman 2004). Bartle (2003) found that players have different styles and make different choices for different scenarios. He classified players into groups based on how they played. These classifications

included explorers, achievers, killers, and socializers (Bartle 2003) and then Yee (2002) added achievement, social interaction, and immersion. For the games to apply to everyone, they have to create with a range of rewards when playing. Kuhlman and Marshello (1975) classified players by cooperative, competitive, or individualistic. Bateman and Boon (2006) found 4 clusters of players styles: conquerors (high on thinking), managers, wanderers (high on feeling and perceiving), and participants. They linked the players to personality traits drawn from the Myer-Briggs Type Indicator. Based on internal and external factors, Przybylski and colleagues developed Player Experience of Need Satisfaction (PENS) to assess players for competence, autonomy, relatedness, intuitive controls, and presence/immersion. PENS is a 21-item survey using a 7-point scale and 5 subscales.

A-11 Summary

There are a wide range of questionnaire-based assessments that have been applied in a wide range of educational setting to a variety of student populations. Common across these various tools is the assessment of the student's preference or comfort within a specific learning domain, task or environment. Similarly, questionnaires are the primary form of personality trait assessment.

A-12 Conclusion

The literature discussed in this report provides evidence that both intrinsic and extrinsic motivation impact the overall effectiveness of an instructional or otherwise educational activity. Evidence was presented from behavioral, cognitive, and physiological/neurological studies. Additionally, the research discussed recommends that the context of the subject or task to be learned and the student's preference or comfort within that context influences their motivation. The context also affects the types of rewards that may motivate, or amotivate, a student.

Research was also presented on the role of personality traits on how an individual perceives their environment, and how they respond to various feedback and reward styles. There was also discussion on how difference environments are more or less suited to different personality profiles. Consequently, there is evidence that suggests the use of an individual's personality profile along with their known preference or comfort for a given task, can be used to tailor the type of reward or reinforcer used to motivate the student.

The reinforcer can be seen as an instructional strategy that is based on the learners motivation. Learner motivation is one of the classifications important for learner characteristics (Goldberg et al. 2012). Research has shown improvement in the

learning rate and retention when using reinforcers (rewards). Customizing for an increase in motivational level based on individual differences, when properly implemented with consideration of the aforementioned, has the potential to optimize learning outcomes when using GIFT.

However, there is much overlap in the construct of motivation with other student affective characteristics. Self-efficacy, which is an individual's belief that they can successfully complete a task or accomplish a goal (Bandura 1997), weighs in on an individual's intrinsic motivation, or interest in performing a task. The study of student autonomy, which is the individual's perceived degree of control over their success in a learning environment (Noels et al. 1999), can be viewed as type of motivational strategy. Specifically, some students demonstrate increased motivation when they have more control over their learning progress (Kember et al. 1999). The point of this discussion is that attempting to precisely measure motivation may be a challenging endeavor, and is likely intermingled with some of these related variables. A recommendation is to leverage the prior research completed on individual characteristics and the types of interactions that they enjoy or perceive as rewarding for developing a framework for implementing a motivational strategy. Specifically, an evaluation of personality up front in the learning process may provide an entry point for identifying the types of instructional strategies or interventions that may increase student motivation. The effectiveness of these strategies can be evaluated through the student's learning performance, level of effort and time spent on task in both real-time and after each instructional session. These evaluations can be used to update the value of effectiveness of the strategy in the long-term learner mode.

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Appendix B. Definition Page

B-1 Demographics

These are obtained through demographic questions (age, gender, etc.).

B-2 Personality

One of the most commonly used set of personality traits is the Big 5 (Goldberg 1981; Dingman 1990; Costa and McCrae; 1986) (Table B-1).

Table B-1 Big 5 personality traits

Trait	Definition	Facets of the trait (Johnson 2014)
Openness	Openness is a person that has traits of being independent, imaginative, many interests, and interest to new experiences.	Imagination Artistic Interest Emotionality Adventurousness Intellect Liberalism
Conscientiousness	The trait of being thoughtful, detailed, organized, self-disciplined, goal-directed and responsible.	Self-efficacy Orderliness Dutifulness Achievement-striving Self-discipline Cautiousness
Extraversion	This trait is related to an individual that is social, talkative, active, and positive emotion	Friendliness Gregariousness Assertiveness Activity level Excitement seeking Cheerfulness
Agreeableness	Agreeableness is a person that is good-natured, thinks of others, helpful, trusting, and very cooperative. Low agreeableness is associated with competition.	Trust Morality Altruism Cooperation Modesty Sympathy
Neuroticism	An individual that feels emotions intensely. They often are associated with anxiety, stress, irritability, or sadness. Predisposed to viewing the environment as negative or threatening.	Anxiety Anger Depression Self-consciousness Immoderation Vulnerability

B-3 Motivation

The variables are identified and defined as the following.

B-3.1 Grit

A person's ability to persist at a lifetime or long-term goal either professional or educational despite failures and challenges (Duckworth and Quinn 2009; Vallerand et al. 2014).

B-3.2 Intrinsic vs. Extrinsic Motivation

Intrinsic Motivation: This is an internal desire and drive to seek, know, accomplish, and stimulate.

Extrinsic Motivation: The source of desire and drive to seek, know, accomplish, and stimulate comes from the external environment; a reinforcer to encourage an individual to learn would be an extrinsic motivator (e.g., del Soldato and du Boulay 1999; Kember et al. 1999; Noels et al. 1999).

B-3.3 Student Autonomy

Locus of control (perceived student autonomy): the student's perception that they are able to influence or control the outcome of events (Deci and Ryan 1985).

Control (actual student autonomy): instructional strategies in which the student is given responsibility for learning (Kember et al. 1999), able to make decisions (Noel et al. 1999), and encouraged to make decisions (Reeve and Deci 1996) regarding their learning progress.

B-3.4 Self-Esteem

A person's overall feeling of worth for themselves (Baumeister 1995; Rosenberg 1979).

B-3.5 Self-Efficacy/Competence

A person's belief about their capability to successfully complete a task to achieve a goal (Bandura 1997).

B-3.6 Goal Orientation

There are 6 types of goal orientation (Elliot et al. 2011):

- Task approach: Motived to do a task correctly

- Task avoidance: Avoiding doing the task incorrectly
- Self- approach: Doing better than before
- Self-avoidance: Avoiding doing worse than before
- Other-approach: Doing better than others
- Other-avoidance: Avoiding doing worse than others

B-3.7 Student Approaches to Learning (SAL)

This approaches are deep, surface, and strategic (Marton and Saljo 1976; Laurillard 1979; Ramsden 1979):

- Deep learners: Actively seek to understand the material/subject. Interact vigorously with the content; make use of evidence, inquiry, and evaluation; relate new ideas to previous knowledge; and tend to read and study beyond the course requirements. Motivated by interest. Tend to have higher grades, retain, and transfer information at higher rates (Biggs 1987).
- Surface learning: Learn to repeat what they have learned. Memorize information and take a narrow view and concentrate on the detail. Fail to distinguish principles from examples and are motivated by fear of failure.
- Strategic learning: Seek to obtain a high grade. Organize time and effort for greatest effect to grade. Only study materials that appropriate. Use previous exams and assessments to predict questions. Motivated by grades.

B-3.8 Affect Predisposition

This reflects sad versus happy, anxious/nervous versus calm/relaxed; pessimistic versus optimistic.

B-3.9 Reinforcement Sensitivity Theory (RST)

(Gray 1970; Gray and McNaughton 2000)

- Behavioral Inhibition System (BIS): the epicenter of anxiety that is activated by sources of conflict and resolution.
- Behavioral Activation System (BAS): mediates responses to conditioned signals of reward and signals of relieving non punishment.
- Fight–Flight–Freeze System (FFFS): mediates reactions .

B-3.10 Values

"Enduring belief that a specific end-state of existence or specific mode of conduct is preferred to a different end-state or mode of conduct for living one's life" (Rokeach 1973). This is a set of models for attitudes, beliefs, and behavior.

B-3.11 Task Interest

This would be to gauge the student's interest in the task to be performed or that was just performed.

B-3.12 Self-Regulation

Emotion: The student's ability to maintain task focus and confidence in the face of criticism and difficulty (Knafer and Heggestad 1999).

Management of learning: the student's ability to apply metacognitive strategies to plan their time, monitor progress, and ensure sufficient effort is extended on the task (Hattie et al. 1996) and to seek information when needed.

B-3.13 Need for Cognition

An individual's tendency to engage in and enjoy effortful cognitive endeavors (Cacioppo et al. 1984).

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Appendix C. Prototype

The appendix appears at it was received without editorial change.

Motivation Assessment

Directions: This motivational assessment is used for an intelligent tutor. To ensure a proper plan, please answer openly and honestly. There are no right or wrong answers. The first answer you think of is usually the best one. The scale below is used to answer the questions. If the statement is true to you, select strongly agree. Click strongly disagree, if it is not true of you. If the statement is more or less true, find the words between strongly agree and strongly disagree that best describes you.

I always work hard to learn because learning is interesting.

- ❍ Strongly disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat disagree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat agree (5)
- ❍ Agree (6)
- ❍ Strongly agree (7)

I am interested in a wide range of topics.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I need to feel in complete control over my learning.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Creating new ideas and being creative is the only motivation I need to learn.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

If I could pick different pathways for learning, I would feel I have more choice over my learning.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I gain interest in a topic as I build more knowledge and understanding.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Understanding the material, provides me the greatest satisfaction.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I have a hard time finding task that are interesting.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

When I am unable to comprehend the material, I am capable of finding it on my own.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I always put in maximum effort to achieve goals.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I start out motivated but lose interest as time goes on.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I start out motivated but lose interest as time goes on.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I do not want to work very hard for this task. I just want to pass.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Learning and understanding the information is more important than the grade I receive.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

My goal when taking this course is to avoid preforming poorly.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

My goal when taking this course is to avoid doing worse on exams than previously.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

My goal when taking a course is to perform better on exams than I have previously.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

My goal when taking this course is to provide the correct answers.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

My goal when taking a course is to understand the material as well as getting the questions correct.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I will not give up and will continue to strive for understanding no matter the complexity of the material.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

When I am tired of a question, I will guess.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Even if the task is boring, I will work hard.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Even when I am tired of a question, I still persist for accuracy.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I like to delay my work until it is necessary.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I do not review any coursework.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I can pass by memorizing the information, even if I do not understand the material.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I try hard so I do not look stupid/dumb compared to my peers.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

When I am unable to comprehend the material, I will only study the easy parts.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I like to pick activities that give me instant progress.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am motivated for my own satisfaction.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I never think beyond what the task is asking me to learn.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I do not try to learn when I am bored.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I often miss important information because my mind wanders.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I always pay attention so I don't miss important information.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I enjoy a task that requires a lot of thinking and challenge.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

It is my fault, if I do not pass or understand the information from the task.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I like to begin a task as soon as its assigned.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am motivated due to social/family pressures.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I do not like to think about abstract concepts.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I prefer tasks that are hard as opposed to easy.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I strive to be meticulous and pay attention to detail to complete task.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I finish any task that I start.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I require stimulants to keep me focused on a boring task.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I always perform poorly on task and test.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Being able to see small successes helps me be more driven to finish.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am confident I will well on assignments and test given to me.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

It's OK to make a mistake because it is just a part of learning.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Thinking about mistakes makes me worry.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I often worry about not meeting others standards.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

When I am nervous, I have a hard time performing.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I welcome feedback because it guides me in learning.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am able to push my fear to the side to begin a task.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I become upset when I answer a question incorrectly.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I don't worry about what others think.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I struggle to remain positive.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am always positive.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I know I am going to get the answers right because I have in the past.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

When I am nervous, I am still able to perform the task to the best of my ability.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I avoid complex task because I may not be successful of provide correct answers.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I take feedback as negative criticism even when its meant to be constructive.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I feel like I have triggers that will make me sad at any moment.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I feel satisfied with my performance on most tasks.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I usually am not satisfied by my performance on a task because I could have done better.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I don't want other students to think I am smarter than them.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I often compare myself to others.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I must receive a score that is similar or better than my peers.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I want to be the best.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am afraid to compare myself to others.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Being embarrassed does not affect me.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I like to compare myself to others in an anonymous manner.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I always perform better than my peers.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I always try to win at anything I do.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I try hard so I do not look stupid/dumb compared to my peers.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I always try to show all my abilities and have peers admire my work.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Being compared to others is something I detest.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I find that in competitive scenarios I lose track of the world around me.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I consistently feel like I am underperforming compared to my peers.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I would try harder if I could work toward a harder goal.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I prefer to write my own goals.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I would remember more if my goal was more difficult.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Reaching smaller accomplishments, helps me drive toward reaching my main goal.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I like tasks where I get to figure out solutions to problems.
- ❍ Like a great deal (1)
- ❍ Like a moderate amount (2)
- ❍ Like a little (3)
- ❍ Neither like nor dislike (4)
- ❍ Dislike a little (5)
- ❍ Dislike a moderate amount (6)
- ❍ Dislike a great deal (7)

It is important for me to know why I need to learn this material.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

You should do as told and follow rules at all times.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am effective at managing my time.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Helping me manage my time will reduce "off task" behavior.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

It would help if the tutor reminded me to remain focused, if too much time passes without answering.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

If I do have a question, I like to find the answer on my own.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I do better when guidance is provided only when I ask for it.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I understand and remember the content better if I am listening to it.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I understand and remember the content better if I am reading.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I understand and remember the content better if I watch a video.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I will understand and remember the content if it remains at a complex level.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I will understand and remember the material better if it is at an easier level.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I only need to read, watch, or listen to the material once in order to remember and understand the material.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I will understand and remember the material if I listen, read, or watch it several times.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I will understand and remember the material better if I take notes.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I can remember content better if I take notes with a paper and pencil.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I need to create my own outline to understand the information.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

A premade outline that I need to fill in helps me learn the information and remain focused.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

A premade outline helps me be more successful but not understand the information.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

When reading, listening, or watching I automatically pick out the important points and details.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

It would help me to have the tutor tell me the main points and details from my learning.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I reflect on my learning for every task.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am more attentive when I feel threatened.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am more attentive when I feel satisfaction.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I need to participate actively in order to understand the material.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am not motivated when I am forced to complete all the practice questions, even though I have been very accurate in answering.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

It would be motivating if I could practice until I felt I understood the information.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I need to be prompted to reflect on my learning.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I don't need reviews because I constantly test myself until I make sure I completely understand the content.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I need the information to be given to me all at once.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

It would be best if I could control the amount of information given to me.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

A checklist/plan would be beneficial to me.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I like to make my own checklist/plan.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I do not like checklists because I already have a plan in my head.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Providing the assessment questions first allows me to learn at a deeper level.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am capable of deciding not to take a pre-assessment because it would waste my time if I was not knowledgeable on the subject.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I know my level of understanding on the topic. I would like the choice to take a pre-assessment if I am knowledgeable to individualize my learning plan.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I would work harder if a pre-assessment let me skip the parts I already know.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

A low score on a pre-assessment would cause me to provide less effort.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I prefer to work in a group.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I like to learn on my own.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

A sequential flow of the content gives me confidence that I will be able to learn the material.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Allowing me to choose the flow of the content motivates me to learn.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I do better when guidance is provided only when I ask for it.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I have a hard time remembering information when I'm learning.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I always perform poorly on tasks and tests.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I feel very tense reading complex material.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I can easily comprehend material.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I would learn more if the tutor did not provide me the answer once I got it wrong.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I would learn more if the tutor gave me the correct answer right away.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I would learn more with guidance, but may try harder if I knew I would receive less points for the hints.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I would learn more if I had to provide a reason to support my answer choice for multiple choice.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

It would be beneficial if the tutor told me to look for the answer before telling me the answer.

- ❑ Strongly agree (1)
- ❑ Agree (2)
- ❑ Somewhat agree (3)
- ❑ Neither agree nor disagree (4)
- ❑ Somewhat disagree (5)
- ❑ Disagree (6)
- ❑ Strongly disagree (7)

If I answer a question incorrectly, it would be beneficial for the tutor to provide me with additional information on the topic.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I will work faster if I know I am under a time constraint.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I learn more when I am assessed at the end of a task.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I learn better if I have to explain my answers as opposed to selecting an answer in a multiple choice format.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am annoyed with too many multiple choice questions.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I learn more when I do not know what I will be assessed on.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I enjoy continuously being assessed to obtain immediate feedback.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Seeing questions before the task limits the amount of information I learn.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I should be given a warning to improve if I am not maintaining full effort.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I find it important to have fun during the task.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

If I provided the wrong answer, it would be beneficial for the tutor to re-ask a similar question later.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Sometimes I am overwhelmed by the amount of information I have to read.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Aesthetics help motivate me.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I find that I perform better when I have breaks.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Knowing I am close to finishing an assessment makes me try harder.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Organization and structure are very important to me.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am more motivated to learn if I have to teach someone else.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Reading complex material excites me.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I don't review any coursework.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I want to pick my own level of complexity, knowing I can change the level at any moment.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I would prefer to let the tutor decide the complexity level I need.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Knowing I will receive a reward for reaching a goal helps me remain focused and provide effort.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I need to be praised often to feel valued.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Surprising or unexpected rewards motivate me.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I love when the instructor uses me as an example to others.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am motivated by acknowledgment from friends and family.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am motivated by acknowledgment from my team mates.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am motivated by acknowledgment from those that have a higher authority than myself.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I would do better if learning turned into a game and competition.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

My image is important to me.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I would perform better if I was anonymously compared to others.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

It is enjoyable to show my teacher I am more knowledgeable than my classmates.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I enjoy sharing my grades/score with others.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I enjoy keeping my grades/score private.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I need to have a break at times to help keep focused.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I need a break after 30 minutes of work.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I need a break after an hour of work.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I don't need any breaks.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

My satisfaction increases when I receive points and feedback on my accomplishments.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I would rather not receive a reward.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I like to see my progress in reaching a goal (progress bar) to remain motivated.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I will try harder if I know the grade will be seen by everyone.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I will try harder if I know that I cannot retake the class for a better grade.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I will work harder if I have to start over if I provide too many incorrect answers.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am motivated to improve my performance when I receive a negative consequence for poor performance.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I should be given a warning to improve if I am not maintaining full effort.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I like to celebrate my accomplishments.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I am motivated when I have challenges that are high risk but also high reward.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I like to be recognized quietly.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I like to be recognized in front of others.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Rewards need to be proportional to my level of effort or they are not worth my effort.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Rewards that are valuable to me change depending on the context.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I take risk even when there is a potential negative consequence.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

I avoid task risks.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

What else motivates you?

What strategy provided to you would influence your effort?

If you could add one thing to learning to keep you motivated, what would it be?

What is the number one thing that prevents you from being more motivated?

Does this item make you want to work harder in order to earn? Select, strongly agree if you would work your hardest for that item. Select, strongly disagree if you would not but forth any more effort in your work for that item. Select the item in the middle that hold true to how much harder you would work to earn.

Electronic badges given through the tutor as you progress through your work.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Achievements provided with points for accomplishing something (e.g. Speed, accuracy, or so many correct in a row)

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Receiving more positive feedback than negative.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Praise regarding my effort instead of how much I know.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Praise on my knowledge instead of praise on my effort.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Praise on both knowledge and effort.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Receiving points throughout the learning process instead of receiving grades at the end.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Having a progress bar that shows my performance relative to my goal.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Having the opportunity to pick the type of assignment (written, multiple choice, oral, or a game).

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Working to get points as a team to boost your score (e.g., If all team members have an A then you get a bonus).

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Playing a beat the clock game.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

An email or test sent to my phone recognizing my efforts and accomplishments.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Playing a digital slot machine for accomplishments.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Having an avatar (person) that I can buy items for with my points.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Owning an army, pet, etc. that I look after and protect with points earned.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Independent free time.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Having an animated clip in the middle of learning.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Having an animated clip in the beginning to pump me up.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Having an animated clip at the end for a mini celebration.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Taking a break with motivational music.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

having motivational music at the beginning.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Being able to listen to music while I learn.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Motivational quotes to help me persist.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

A mystery jackpot (e.g., your name is pulled out of a drawing for meeting a goal).

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Providing a donation to a charity.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Have free time to volunteer.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Spending time with your friends or family.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

The opportunity to help tutor someone about the knowledge you successfully learned.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Watch a sports game.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Having a longer lunch than normal.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Leave work early.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Sleep in and arrive to work/school later.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Have a paid day off.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Play a board game.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Play a video game.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Watch a movie.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Spending extra time with your family.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Extra time to hang out with your classmates or team.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Time to hang out with your friends.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Dancing
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Singing
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

A special parking spot.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Having someone do your dishes, laundry, or cleaning.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Reading a book.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Spending time with someone in a higher command to learn from them.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Playing or watching football.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Fishing.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Use of a fitness center.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Practicing at a shooting range.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Time to work out.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Time to do an outdoor adventure (e.g. climbing, biking, camping, or skydiving)
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Going to see a theater play or music concert.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Creativity time with art.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

A photography class or time to take pictures.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Swimming.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Time to work in the garden.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Play a round of golf.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Boating.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Lifting weights.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Playing tennis or racquetball.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Go off-roading
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Being able to run errands in the middle of the day.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Having your hair done.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Go shopping.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Getting a manicure or pedicure.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Raising your chances of a promotion.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

A trip to go visit a friend/family who lives far away.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Going to a theme park.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Hiking.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Thrill seeking adventures such as bungee jumping, scuba diving, skydiving etc.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Going to see a concert.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

A relaxation room

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Playing an instrument

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

A massage.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

A certificate of completion for my portfolio.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

A gift card.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Extra pay on a check or bonus.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Receiving money.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Receiving small gifts.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Free beverage.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Free food.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Receiving free coffee or tea.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Receiving a hug.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Subscription to a magazine.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Renting a sports car.

- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Have a teammate cook dinner for you.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Q293 Physical badges to show your accomplishments.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Q294 Subsidized childcare.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Q295 Losing points because you answered incorrectly.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Q296 Losing points because you answered multiple questions incorrectly.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Q297 Loss of points from failing.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Q298 Starting the course over because you had too many questions wrong.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Q299 Receiving acknowledgments from each class (e.g. highest score, most improved).
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Q300 In a meeting, be acknowledged for your work.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Q301 My name on an honor roll.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Q302 Being able to search for others scores.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Q303 Having your achievements hung on the wall.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Q304 Award ceremonies.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Q305 A leader board that compares you to others.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Q306 Allowing others to provide comments and likes on your answers and effort.
- ❍ Strongly agree (1)
- ❍ Agree (2)
- ❍ Somewhat agree (3)
- ❍ Neither agree nor disagree (4)
- ❍ Somewhat disagree (5)
- ❍ Disagree (6)
- ❍ Strongly disagree (7)

Are there other reinforcers that would make you work harder? Please list them.

You have completed all the questionnaires. Your responses will enable us to understand how individuals are motivated. Thank you for participating!

List of Symbols, Abbreviations, and Acronyms

ABA	Applied behavior analysis
AR	augmented reality
ARCS	Attention, Relevance, Confidence, and Satisfaction Model
ARL	US Army Research Laboratory
ASA	attraction–selection–attrition
BIP	behavioral intervention plans
BAS	behavioral avoidance scale
BIS	behavioral inhibition scale
CAMBRA	Causal Analytical Modeling via Blocked Regression Analysis
CBT	Computer Based Tutoring
DA	Dopamine
DRL	Differential reinforcement rate of low rates
DRRPI	Dunn-Rankin Reward Preference Inventory
EBR	eye blink rate
ECG	electrocardiogram
EF	elaborated feedback
EPQ-R Short Form	Eysenck Personality Questionnaire- Revised Short Form
FBA	functional behavioral assessments
fMRI	functional magnetic resonance imaging
GIFT	Generalized Intelligent Framework for Tutoring
HR	heart rate
IDs	Instructional Designers
I-E-O	input–environment–outcome
IMI	Intrinsic Motivation Inventory

IMMS	Instructional Materials Motivation Survey
IPIP	International Personality Item Pool
IRB	Internal Review Board
ISD	Instructional System Design
ISD	Instructional Systems Design
IST, UCF	Institute for Simulation and Training at the University of Central Florida
ITS	Intelligent Tutoring System
KCR	knowledge of correct response
KR	knowledge of results
LRS	Learner Record Store
LTLM	Long Term Learner Model
LTP	long term potentiation
MAT	Motivator Assessment Tool
MLSQ	Motivated Learning Strategies Questionnaire
RR-PVQ	Revised and Refined- Portrait Values Questionnaire
MOOC	Massive Open Online Course
MSLQ	Motivated Strategies for Learning Questionnaire
MTL	medial temporal lobe
MTURK	Amazon Mechanical Turk
NAc	nucleus accumbens
NEO-FFI	NEO Five Factor Inventory
OIT	Organismic Integration Theory
OMQ	Online-Motivation Questionnaire
PALS	Patterns of Adaptive Learning Survey
PBS	Positive Behavioral Supports
PENS	Player Experience of Need Satisfaction

PFC	prefrontal cortex
RIMMS	Reduced Instructional Materials Motivation Survey
RL	reward related process
RPE	Reward prediction error
SAL	Student Approaches to Learning
SDT	self-determination theory
SRL	Self-regulated Learning
TIPI	Ten Item Personality measure
VR	virtual reality
VTA	ventral tegmental area

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